SCIENCE

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ADDRESS OF THE PRESIDENT BEFORE THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, BRISTOL, 1898.

II.

HAVING kept you for the last half hour rigorously chained to earth, disclosing dreary possibilities, it will be a relief to soar to the heights of pure science and to discuss a point or two touching its latest achievements and aspirations. The low temperature researches which bring such renown to Professor Dewar and to his laboratory in the Royal Institution have been crowned during the present year by the conquest of one of Nature's most defiant strongholds. On the 10th of last May Professor Dewar wrote to me these simple but victorious words: "This evening I have succeeded in liquefying both hydrogen and helium. The second stage of low-temperature work has begun." Static hydrogen boils at a temperature of 238° C. at ordinary pressure, and at 250° C. in a vacuum, thus enabling us to get within 23° of absolute zero. The density of liquid hydrogen is only one-fourteenth that of water, yet in spite of such a low density it collects well, drops easily and has a well-defined meniscus. With proper isolation it will be as easy to manipulate liquid hydrogen as liquid air.

The investigation of the properties of bodies brought near the absolute zero of temperature is certain to give results of extraordinary importance. Already platinum

resistance thermometers are becoming useless, as the temperature of boiling hydrogen is but a few degrees from the point where the resistance of platinum would be practically nothing or the conductivity infinite.

Several years ago I pondered on the constitution of matter in what I ventured to call the fourth state. I endeavored to probe the tormenting mystery of the atom. What *is* the atom? Is a single atom in space solid, liquid or gaseous? Each of these states involve ideas which can only pertain to vast collections of atoms. Whether, like Newton, we try to visualize an atom, as a hard, spherical body, or, with Boscovitch and Faraday, to regard it as a center of force, or accept the vortex atom theory of Lord Kelvin, an isolated atom is an unknown entity difficult to conceive. The properties of matter—solid, liquid, gaseous—are due to molecules in a state of motion. Therefore, matter as we know it involves essentially a mode of motion; and the atom itself—intangible, invisible and inconceivable—is its material basis, and may, indeed, be styled the only true *matter*. The space involved in the motions of atoms has no more pretension to be called matter than the sphere of influence of a body of riflemen—the sphere filled with flying leaden missiles—has to be called lead. Since what we call matter essentially involves a mode of motion, and since at the temperature of absolute zero all atomic motions would stop, it follows that matter as we know it would at that paralyzing temperature probably entirely change its properties. Although a discussion of the ultimate absolute properties of matter is purely speculative, it can hardly be barren, considering that in our laboratories we are now within moderate distance of the absolute zero of temperature.

I have dwelt on the value and importance of nitrogen, but I must not omit to bring to your notice those little known and curiously related elements which during the past twelve months have been discovered and partly described by Professor Ramsay and Dr. Travers. For many years my own work has been among what I may call the waste heaps of the mineral elements. Professor Ramsay is dealing with vagrant atoms of an astral nature. During the course of the present year he has announced the existence of no fewer than three new gases—krypton, neon and metargon. Whether these gases, chiefly known by their spectra, are true, unalterable elements, or whether they are compounded of other known or unknown bodies, has yet to be proved. Fellow workers freely pay tribute to the painstaking zeal with which Professor Ramsay has conducted a difficult research, and to the philosophic subtlety brought to bear on his investigations. But, like most discoverers, he has not escaped the flail of severe criticism.

There is still another claimant for celestial honors. Professor Nasini tells us he has discovered, in some volcanic gases at Pozzuoli, that hypothetical element, coronium, supposed to cause the bright line 5316.9 in the spectrum of the sun's corona. Analogy points to its being lighter and more diffusible than hydrogen, and a study of its properties cannot fail to yield striking results. Still awaiting discovery by the fortunate spectroscopist are the unknown celestial elements, aurorium, with a characteristic line at 5570.7, and nebulum, having two bright lines at 5007.05 and 4959.02.

The fundamental discovery by Hertz, of the electro-magnetic waves predicted more than thirty years ago by Clerk Maxwell, seems likely to develop in the direction of a practical application which excites keen interest—I mean the application to electric signalling across moderate distances without connecting wires. The feasibility of this method of signalling has been demonstrated by several experimenters at more than one meeting of the British Association,

though most elaborately and with many optical refinements by Oliver Lodge at the Oxford meeting in 1894. But not until Signor Marconi induced the British post-office and foreign governments to try large scale experiments did wireless signalling become generally and popularly known or practically developed as a special kind of telegraphy. Its feasibility depends on the discovery of a singularly sensitive detector for Hertz waves—a detector whose sensitiveness in some cases seems almost to compare with that of the eye itself. The fact noticed by Oliver Lodge in 1889, that an infinitesimal metallic gap subjected to an electric jerk became conducting, so as to complete an electric circuit, was rediscovered soon afterwards in a more tangible and definite form and applied to the detection of Hertz waves by M. E. Branly. Oliver Lodge then continued the work, and produced the *vacuum filing-tube* coherers with automatic tapper-back, which are of acknowledged practical service. It is this varying continuity of contact under the influence of extremely feeble electric stimulus alternating with mechanical tremor which, in combination with the mode of producing the waves revealed by Hertz, constitutes the essential and fundamental feature of 'wireless telegraphy.' There is a curious and widely-spread misapprehension about coherers, to the effect that to make a coherer work the wave must fall upon it. Oliver Lodge has disproved this fallacy. Let the wave fall on a suitable receiver, such as a metallic wire, or, better still, on an arrangement of metal wings resembling a Hertz sender, and the waves set up oscillating currents which may be led by wires (enclosed in metal pipes) to the coherer. The coherer acts apparently by a species of end-impact of the oscillatory current, and does not need to be attacked in the flank by the waves themselves. This interesting method of signalling—already developing in Marconi's hands into a successful practical system which inevitably will be largely used in lighthouse and marine work—presents more analogy to optical signals by flash-light than to what is usually understood as electric telegraphy, notwithstanding the fact that an ordinary Morse instrument at one end responds to the movements of a key at the other, or, as arranged by Alexander Muirhead, a siphon recorder responds to an automatic transmitter at about the rate of slow cable telegraphy. But although no apparent optical apparatus is employed, it remains true that the impulse travels from sender to receiver by essentially the same process as that which enables a flash of magnesium powder to excite a distant eye.

The phenomenon discovered by Zeeman, that a source of radiation is affected by a strong magnetic field in such a way that light of one refrangibility becomes divided usually into three components, two of which are displaced by diffraction analysis on either side of the mean position and are oppositely polarized to the third or residual constituent, has been examined by many observers in all countries. The phenomenon has been subjected to photography with conspicuously successful results by Professor T. Preston in Dublin and by Professor Michelson and Dr. Ames and others in America.

It appears that the different lines in the spectrum are differently affected, some of them being tripled with different grades of relative intensity, some doubled, some quadrupled, some sextupled and some left unchanged. Even the two components of the D lines are not similarly influenced. Moreover, whereas the polarization is usually such as to indicate that motions of a negative ion or electron constitute the source of light, a few lines are stated by the observers at Baltimore, who used what they call the 'small' grating of five inches' width

ruled with 65,000 lines, to be polarized in the reverse way.

Further prosecution of these researches must lead to deeper insight into molecular processes and the mode in which they affect the ether; indeed, already valuable theoretic views have been promulgated by H. A. Lorenz, J. Larmor and G. F. Fizgerald, on the lines of the radiation theory of Dr. Johnstone Stoney; and the connection of the new phenomena with the old magnetic rotation of Faraday is under discussion. It is interesting to note that Faraday and a number of more recent experimenters were led by theoretical considerations to look for some such effect; and, though the inadequate means at their disposal did not lead to success, nevertheless a first dim glimpse of the phenomenon was obtained by M. Fievez, of the Royal Observatory at Brussels, in 1885.

It would be improper to pass without at least brief mention the remarkable series of theoretic papers by Dr. J. Larmor, published by the Royal Society, on the relationship between ether and matter. By the time these researches become generally intelligible they may be found to constitute a considerable step toward the further mathematical analysis and interpretation of the physical universe on the lines initiated by Newton.

In the mechanical construction of Röntgen-ray tubes I can record a few advances, the most successful being the adoption of Professor Silvanus P. Thompson's suggestion of using for the anti-cathode a metal of high atomic weight. Osmium and iridium have been used with advantage, and osmium anti-cathode tubes are now a regular article of manufacture. As long ago as June, 1896, X-ray tubes with metallic uranium anti-cathodes were made in my own laboratory, and were found to work better than those with platinum. The difficulty of procuring metallic uranium prevented these experiments from being continued. Thorium anti-cathodes have also been tried.

Röntgen has drawn fresh attention to a fact very early observed by English experimenters—that of the non-homogeneity of the rays and the dependence of their penetrating power on the degree of vacuum; rays generated in high vacua have more penetrative power than when the vacuum is less high. These facts are familiar to all who have exhausted focus tubes on their own pumps. Röntgen suggests a convenient phraseology; he calls a low-vacuum tube, which does not emit the highly penetrating rays, a 'soft' tube, and a tube in which the exhaustion has been pushed to an extreme degree, in which highly-penetrating rays predominate, a 'hard' tube. Using a 'hard' tube, he took a photograph of a double-barrelled rifle, and showed not only the leaden bullets within the steel barrels, but even the wads and the charges.

Benoit has re-examined the alleged relation between density and opacity to the rays, and finds certain discrepancies. Thus, the opacity of equal thicknesses of palladium and platinum are nearly equal, whilst their densities and atomic weights are very different, those of palladium being about half those of platinum.

At the last meeting of the British Association visitors saw—at the McGill University—Professors Cox and Callendar's appartus for measuring the velocity of Röntgen rays. They found it to be certainly greater than 200 kilometers per second. Majorana has made an independent determination, and finds the velocity to be 600 kilometers per second with an inferior limit certainly of not less than 150 kilometers per second. It may be remembered that J. J. Thomson has found for cathode rays a velocity of more than 10,000 kilometers per second, and it is extremely unlikly that the velocity of Röntgen rays will prove to be less.

Trowbridge has verified the fact, previously announced by Professor S. P. Thompson, that fluor-spar, which by prolonged heating has lost its power of luminescing when reheated, regains the power of thermo-luminescence when exposed to Röntgen rays. He finds that this restoration is also effected by exposure to the electric-glow discharge, but not by exposure to the ultra-violet light. The difference is suggestive.

As for the action of Röntgen rays on bacteria, often asserted and often denied, the latest statement by Dr. H. Rieder, of Munich, is to the effect that bacteria are killed by the discharge from 'hard' tubes. Whether the observation will lead to results of pathologic importance remains to be seen. The circumstance that the normal retina of the eye is slightly sensitive to the rays is confirmed by Dorn and by Röntgen himself.

The essential wave-nature of the Röntgen rays appear to be confirmed by the fact ascertained by several of our great mathematical physicists, that light of excessively short wave-length would be but slightly absorbed by ordinary material media, and would not in the ordinary sense be refracted at all. In fact, a theoretic basis for a comprehension of the Röntgen rays had been propounded before the rays had been discovered. At the Liverpool meeting of the British Association several speakers, headed by Sir George Stokes, expressed their conviction that the disturbed electric field caused by the sudden stoppage of the motion of an electrically-charged atom yielded the true explanation of the phenomena extraneous to the Crookes high-vacuum tubes —phenomena so excellently elaborated by Lenard and by Röntgen. More recently Sir George Stokes has re-stated his 'pulse' theory, and fortified it with arguments which have an important bearing on the whole theory of the refraction of light. He still holds to their essentially transverse nature, in spite of the absence of polarization, an absence once more confirmed by the careful experiments of Dr. L. Graetz. The details of this theory are in process of elaboration by Professor J. J. Thomson.

Meantime, while the general opinion of physicists seems to be settling towards a wave or ether theory for the Röntgen rays, an opposite drift is apparent with respect to the physical nature of the cathode rays; it beomes more and more clear that cathode rays consist of electrified atoms or ions in rapid progressive motion. My idea of a fourth state of matter, propounded in 1881,* and at first opposed at home and abroad, is now becoming accepted. It is supported by Professor J. J. Thomson.† Dr. Larmor's theory‡ likewise involves the idea of an ionic substratum of matter; the view is also confirmed by Zeeman's phenomenon. In Germany—where the term cathode ray was invented almost as a protest against the theory of molecular streams propounded by me at the Sheffield meeting of the British Association in 1879—additional proofs have been produced in favor of the doctrine that the essential fact in the phenomenon is electrified radiant matter.

The speed of these molecular streams has been approximately measured, chiefly by aid of my own discovery nearly twenty years ago, that their path is curved in a magnetic field, and that they produce phosphorescence where they impinge on an obstacle. The two unknown quantities, the charge and the speed of each atom, are measurable from the amount of curvature and by means of one other independent experiment.

It cannot be said that a complete and conclusive theory of these rays has yet been formulated. It is generally accepted that collisions among particles, especially

**Phil. Trans.*, Part 2, 1881, pp. 433–434.
†*Phil. Mag.*, October, 1897, p. 312.
‡*Phil. Mag.*, December, 1897, p. 506.

the violent collisions due to their impact on a massive target placed in their path, give rise to the interesting kind of extremely high frequency radiation discovered by Röntgen. It has, indeed, for some time been known that, whereas a charged body in motion constitutes an electric current, the sudden stoppage, or any violent acceleration of such a body, must cause an alternating electric disturbance, which, though so rapidly decaying in intensity as to be practically 'dead beat,' yet must give rise to an ethereal wave or pulse travelling with the speed of light, but of a length comparable to the size of the body whose sudden change of motion caused the disturbance. The emission of a high-pitched musical sound from the jolting of a dustman's cart (with a spring bell hung on it) has been suggested as an illustration of the way in which the molecules of any solid not at absolute zero may possibly emit such rays.

If the target on to which the electrically-charged atoms impinge is so constituted that some of its minute parts can thereby be set into rythmical vibration, the energy thus absorbed reappears in the form of light, and the body is said to phosphoresce. The efficient action of the phosphorescent target appears to depend as much on its physical and molecular as on its chemical constitution. The best known phosphori belong to certain well-defined classes, such as the sulphides of the alkaline-earthy metals, and some of the so-called rare earths; but the phosphorescent properties of each of these groups are profoundly modified by an admixture of foreign bodies —witness the effect on the lines in the phosphorescent spectrum of yttrium and samarium produced by traces of calcium or lead. The persistence of the samarium spectrum in presence of overwhelming quantities of other metals is almost unexampled in spectroscopy; thus one part of samaria can easily be seen when mixed with three million parts of lime.

Without stating it as a general rule, it seems as if with a non-phosphorescing target the energy of molecular impact reappears as pulses so abrupt and irregular that, when resolved, they furnish a copious supply of waves of excessively short wave-length—in fact, the now well-known Röntgen rays. The phosphorescence so excited may last only a small fraction of a second, as with the constituents of yttria, where the duration of the different lines varies between the 0.003 and the 0.0009 second; or it may linger for hours, as in the case of some of the yttria earths, and especially with the earthy sulphides, where the glow lasts bright enough to be commercially useful. Excessively phosphorescent bodies can be excited by light waves, but most of them require the stimulus of electrical excitement.

It now appears that some bodies, even without special stimulation, are capable of giving out rays closely allied, if not in some cases identical, with those of Professor Röntgen. Uranium and thorium compounds are of this character, and it would almost seem, from the important researches of Dr. Russell, that this ray-emitting power may be a general property of matter, for he has shown that nearly every substance is capable of affecting the photographic plate if exposed in darkness for sufficient time.

No other source for Röntgen rays but the Crookes tube has yet been discovered, but rays of kindred sorts are recognized. The Becquerel rays, emitted by uranium and its compounds, have now found their companions in rays—discovered almost simultaneously by Curie and Schmidt—emitted by thorium and its compounds. The thorium rays affect photographic plates through screens of paper or aluminium, and are absorbed by metals and other dense bodies. They ionize the air, making it an electrical

conductor; and they can be refracted and probably reflected, at least diffusively. Unlike uranium rays, they are not polarized by transmission through tourmaline, therefore resembling in this respect the Röntgen rays.

Quite recently M. and Mdme. Curie have announced a discovery which, if confirmed, cannot fail to assist the investigation of this obscure branch of physics. They have brought to notice a new constituent of the uranium mineral pitchblende, which in a 400-fold degree possesses uranium's mysterious power of emitting a form of energy capable of impressing a photographic plate and of discharging electricity by rendering air a conductor. It also appears that the radiant activity of the new body, to which the discoverers have given the name of polonium, needs neither the excitation of light nor the stimulus of electricity; like uranium, it draws its energy from some constantly regenerating and hitherto unsuspected store, exhaustless in amount.

It has long been to me a haunting problem how to reconcile this apparently boundless outpour of energy with accepted canons. But, as Dr. Johnstone Stoney reminds me, the resources of molecular movements are far from exhausted. There are many stores of energy in nature that may be drawn on by properly constituted bodies without very obvious cause. Some time since I drew attention to the enormous amount of locked-up energy in the ether; nearer our experimental grasp are the motions of the atoms and molecules, and it is not difficult mentally so to modify Maxwell's demons as to reduce them to the level of an inflexible law and thus bring them within the ken of a philosopher in search of a new tool. It is possible to conceive a target capable of mechanically sifting from the molecules of the surrounding air the quick from the slow movers. This sifting of the swift moving molecules is effected in liquids whenever they evaporate, and in the case of the constituents of the atmosphere, wherever it contains constituents light enough to drift away molecule by molecule. In my mind's eye I see such a target as a piece of metal cooler than the surrounding air acquiring the energy that gradually raises its temperature from the outstanding effect of all its encounters with the molecules of the air about it; I see another target of such a structure that it throws off the slow moving molecules with little exchange of energy, but is so influenced by the quick moving missiles that it appropriates to itself some of their energy. Let uranium or polonium, bodies of densest atoms, have a structure that enables them to throw off the slow moving molecules of the atmosphere, while the quick moving molecules, smashing on to the surface, have their energy reduced and that of the target correspondingly increased. The energy thus gained seems to be employed partly in dissociating some of the molecules of the gas (or in inducing some other condition which has the effect of rendering the neighboring air in some degree a conductor of electricity) and partly in originating an undulation through the ether, which, as it takes its rise in phenomena so disconnected as the impacts of the molecules of the air, must furnish a large contingent of light waves of short wave-length. The shortness in the case of these Becquerel rays appears to approach without attaining the extreme shortness of ordinary Röntgen rays. The reduction of the speed of the quick moving molecules would cool the layer of air to which they belong, but this cooling would rapidly be compensated by radiation and conduction from the surrounding atmosphere; under ordinary circumstances the difference of temperature would scarcely be perceptible, and the uranium would thus appear to perpetually emit rays of energy with no apparent means of restoration.

The total energy of both the translational

and internal motions of the molecules locked up in quiescent air at ordinary pressure and temperature is about 140,000 foot-pounds in each cubic yard of air. Accordingly the quiet air within a room 12 feet high, 18 feet wide and 22 feet long contains energy enough to propel a one-horse engine for more than twelve hours. The store drawn upon naturally by uranium and other heavy atoms only awaits the touch of the magic wand of Science to enable the twentieth century to cast into the shade the marvels of the nineteenth.

Whilst placing before you the labors and achievements of my comrades in science I seize this chance of telling you of engrossing work of my own on the fractionation of yttria to which for the last eighteen years I have given ceaseless attention. In 1883, under the title of 'Radiant Matter Spectroscopy,' I described a new series of spectra produced by passing the phosphorescent glow of yttria, under molecular bombardment *in vacuo*, through a train of prisms. The visible spectra in time gave up their secrets, and were duly embalmed in the *Philosophical Transactions*. At the Birmingham meeting of the British Association in 1886 I brought the subject before the Chemical Section, of which I had the honor to be President. The results led to many speculations on the probable origin of all the elementary bodies—speculations that for the moment I must waive in favor of experimental facts.

There still remained for spectroscopic examination a long tempting stretch of unknown ultra-violet light, of which the exploration gave me no rest. But I will not now enter into details of the quest of unknown lines. Large quartz prisms, lenses and condensers, specially sensitized photographic films capable of dealing with the necessary small amount of radiation given by feebly phosphorescing substances,* and, above all, tireless patience in collating and interpreting results, have all played their part. Although the research is incomplete, I am able to announce that among the groups of rare earths giving phosphorescent spectra in the visible region there are others giving well-defined groups of bands which can only be recorded photographically. I have detected and mapped no less than six such groups extending to λ 3060.

Without enlarging on difficulties, I will give a brief outline of the investigation. Starting with a large quantity of a group of the rare earths in a state of considerable purity, a particular method of fractionation is applied, splitting the earths into a series of fractions differing but slightly from each other. Each of these fractions, phosphorescing *in vacuo*, is arranged in the spectrograph, and a record of its spectrum photographed upon a specially prepared sensitive film.

In this way, with different groups of rare earths, the several invisible bands were recorded—some moderately strong, others exceedingly faint. Selecting a portion giving a definite set of bands, new methods of fractionation were applied, constantly photographing and measuring the spectrum of each fraction. Sometimes many weeks of hard experiment failed to produce any separation, and then a new method of splitting up was devised and applied. By unremitting work—the solvent of most difficulties—eventually it was possible to split up the series of bands into various groups. Then, taking a group which seemed to offer possibilities of reasonably quick result, one method after another of chemical attack was adopted, with the ultimate result of freeing the group from its accompanying

*In this connection I am glad to acknowledge my indebtedness to Dr. Schumann, of Leipzig, for valuable suggestions and detail of his own apparatus, by means of which he has produced some unique records of metallic and gaseous spectra of lines of short wave-length.

fellows and increasing its intensity and detail.

As I have said, my researches are far from complete, but about one of the bodies I may speak definitely. High up in the ultra-violet, like a faint nebula in the distant heavens, a group of lines was detected, at first feeble and only remarkable on account of their isolation. On further purification these lines grew stronger. Their great refrangibility cut them off from other groups. Special processes were employed to isolate the earth, and using these lines as a test, and appealing at every step to the spectrograph, it was pleasant to see how each week the group stood out stronger and stronger, while the other lines of yttrium, samarium, ytterbium, etc., became fainter, and, at last, practically vanishing, left the sought-for group strong and solitary. Finally, within the last few weeks, hopefulness has emerged into certainty, and I have absolute evidence that another member of the rare earth groups has been added to the list. Simultaneously with the chemical and spectrographic attack, atomic-weight determinations were constantly performed.

As the group of lines which betrayed its existence stand alone, almost at the extreme end of the ultra-violet spectrum, I propose to name the newest of the elements Monium, from the Greek μόνος, alone. Although caught by the searching rays of the spectrum, monium offers a direct contrast to the recently discovered gaseous elements, by having a strongly-marked individuality; but, although so young and willful, it is willing to enter into any number of chemical alliances.

Until my material is in a greater state of purity I hesitate to commit myself to figures, but I may say that the wave-lengths of the principal lines are 3120 and 3117. Other fainter lines are at 3219, 3064 and 3060. The atomic weight of the element, based on the assumption of R_2O_3, is not far from 118—greater than that accepted for yttrium and less than that for lanthanum.

I ought almost to apologize for adding to the already too long list of elements of the rare earth class—the asteroids of the terrestrial family. But as the host of celestial asteroids, unimportant individually, become of high interest when once the idea is grasped that they may be incompletely coagulated remains of the original nebula, so do these elusive and insignificant rare elements rise to supreme importance when we regard them in the light of component parts of a dominant element, frozen in embryo, and arrested in the act of coalescing from the original protyle into one of the ordinary and law-abiding family for whom Newlands and Mendeleeff have prepared pigeon-holes. The new element has another claim to notice. Not only is it new in itself, but to discover it a new tool had to be forged for spectroscopic research.

Further details I will reserve for that tribunal before whom every aspirant for a place in the elemental hierarchy has to substantiate his claim.

These, then, are some of the subjects, weighty and far-reaching, on which my own attention has been chiefly concentrated. Upon one other interest I have not yet touched—to me the weigtiest and the farthest reaching of all.

No incident in my scientific career is more widely known than the part I took many years ago in certain psychic researches. Thirty years have passed since I published an account of experiments tending to show that outside our scientific knowledge there exists a Force exercised by intelligence differing from the ordinary intelligence common to mortals. This fact in my life is, of course, well understood by those who honored me with the invitation to become your President. Perhaps among my audience some may feel curious as to whether I shall speak out or be silent. I elect to speak,

although briefly. To enter at length on a still debatable subject would be unduly to insist an a topic which—as Wallace, Lodge and Barrett have already shown—though not unfitted for discussion at these meetings, does not yet enlist the interest of the majority of my scientific brethren. To ignore the subject would be an act of cowardice—an act of cowardice I feel no temptation to commit.

To stop short in any research that bids fair to widen the gates of knowledge, to recoil from fear of difficulty or adverse criticism, is to bring reproach on science. There is nothing for the investigator to do but to go straight on; 'to explore up and down, inch by inch, with the taper his reason;' to follow the light wherever it may lead, even should it at times resemble a will-o'-the-wisp. I have nothing to retract. I adhere to my already published statements. Indeed, I might add much thereto. I regret only a certain crudity in those early expositions which, no doubt justly, militated against their acceptance by the scientific world. My own knowledge at that time scarcely extended beyond the fact that certain phenomena new to science had assuredly occurred, and were attested by my own sober senses and, better still, by automatic record. I was like some two-dimensional being who might stand at the singular point of a Riemann's surface, and thus find himself in infinitesimal and inexplicable contact with a plane of existence not his own.

I think I see a little farther now. I have glimpses of something like coherence among the strange elusive phenomena; of something like continuity between those unexplained forces and laws already known. This advance is largely due to the labors of another association of which I have also this year the honor to be President—the Society for Psychical Research. And were I now introducing for the first time these inquiries to the world of science I should choose a starting-point different from that of old. It would be well to begin with *telepathy;* with the fundamental law, as I believe it to be, that thoughts and images may be transferred from one mind to another without the agency of the recognized organs of sense—that knowledge may enter the human mind without being communicated in any hitherto known or recognized ways.

Although the inquiry has elicited important facts with reference to the mind, it has not yet reached the scientific stage of certainty which would entitle it to be usefully brought before one of our Sections. I will, therefore, confine myself to pointing out the direction in which scientific investigation can legitimately advance. If telepathy take place we have two physical facts—the physical change in the brain of A, the suggester, and the analogous physical change in the brain of B, the recipient of the suggestion. Between these two physical events there must exist a train of physical causes. Whenever the connecting sequence of intermediate causes begins to be revealed, the inquiry will then come within the range of one of the Sections of the British Association. Such a sequence can only occur through an intervening medium. All the phenomena of the universe are presumably in some way continuous, and it is unscientific to call in the aid of mysterious agencies when, with every fresh advance in knowledge, it is shown that ether vibrations have powers and attributes abundantly equal to any demand—even to the transmission of thought. It is supposed by some physiologists that the essential cells of nerves do not actually touch, but are separated by a narrow gap which widens in sleep, while it narrows almost to extinction during mental activity. This condition is so singularly like that of a Branly or Lodge coherer as to suggest a further analogy.

The structure of brain and nerve being similar, it is conceivable there may be present masses of such nerve coherers in the brain whose special function it may be to receive impulses brought from without through the connecting sequence of ether waves of appropriate order of magnitude. Röntgen has familiarized us with an order of vibrations of extreme minuteness compared with the smallest waves with which we have hitherto been acquainted, and of dimensions comparable with the distances between the centers of the atoms of which the material universe is built up; and there is no reason to suppose that we have here reached the limit of frequency. It is known that the action of thought is accompanied by certain molecular movements in the brain, and here we have physical vibrations capable, from their extreme minuteness, of acting direct on individual molecules, while their rapidity approaches that of the internal and external movements of the atoms themselves.

Confirmation of telepathic phenomena is afforded by many converging experiments and by many spontaneous occurrences only thus intelligible. The most varied proof, perhaps, is drawn from analysis of the subconscious workings of the mind, when these, whether by accident or design, are brought into conscious survey. Evidence of a region below the threshold of consciousness has been presented, since its first inception, in the *Proceedings of the Society for Psychical Research;* and its various aspects are being interpreted and welded into a comprehensive whole by the pertinacious genius of F. W. H. Myers. Concurrently, our knowledge of the facts in this obscure region has received valuable additions at the hands of laborers in other countries. To mention a few names out of many, the observations of Richet, Pierre Janet and Binet (in France), of Breuer and Freud (in Austria), of William James (in America), have strikingly illustrated the extent to which patient experimentation can probe subliminal processes, and can thus learn the lessons of alternating personalities and abnormal states. Whilst it is clear that our knowledge of subconscious mentation is still to be developed, we must beware of rashly assuming that all variations from the normal waking condition are necessarily morbid. The human race has reached no fixed or changeless ideal; in every direction there is evolution as well as disintegration. It would be hard to find instances of more rapid progress, moral and physical, than in certain important cases of cure by suggestion—again to cite a few names out of many—by Liébeault, Bernheim, the late Auguste Voisin, Bérillon (in France), Schrenck-Notzing (in Germany), Forel (in Switzerland), van Eeden (in Holland), Wetterstrand (in Sweden), Milne-Bramwell and Lloyd Tuckey (in England). This is not the place for details, but the *vis medicatrix* thus evoked, as it were, from the depths of the organism, is of good omen for the upward evolution of mankind.

A formidable range of phenomena must be scientifically sifted before we effectually grasp a faculty so strange, so bewildering, and for ages so inscrutable, as the direct action of mind on mind. This delicate task needs a rigorous employment of the method of exclusion—a constant setting aside of irrelevant phenomena that could be explained by known causes, including those far too familiar causes, conscious and unconscious fraud. The inquiry unites the difficulties inherent in all experimentation connected with *mind*, with tangled human temperaments and with observations dependent less on automatic record than on personal testimony. But difficulties are things to be overcome even in the elusory branch of research known as Experimental Psychology. It has been characteristic of the leaders among the group of inquirers constituting

the Society for Psychical Research to combine critical and negative work with work leading to positive discovery. To the penetration and scrupulous fair-mindedness of Professor Henry Sidgwick and of the late Edmund Gurney is largely due the establishment of canons of evidence in psychical research, which strengthen while they narrow the path of subsequent explorers. To the detective genius of Dr. Richard Hodgson we owe a convincing demonstration of the narrow limits of human continuous observation.

It has been said that 'Nothing worth the proving can be proved, nor yet disproved.' True though this may have been in the past, it is true no longer. The science of our century has forged weapons of observation and analysis by which the veriest tyro may profit. Science has trained and fashioned the average mind into habits of exactitude and disciplined perception, and in so doing has fortified itself for tasks higher, wider, and incomparably more wonderful than even the wisest among our ancestors imagined. Like the souls in Plato's myth that follow the chariot of Zeus, it has ascended to a point of vision far above the earth. It is henceforth open to science to transcend all we now think we know of matter, and to gain new glimpses of a profounder scheme of Cosmic Law.

An eminent predecessor in his chair declared that "by an intellectual necessity he crossed the boundary of experimental evidence, and discerned in that matter, which we in our ignorance of its latent powers, and notwithstanding our professed reverence for its Creator, have hitherto covered with opprobrium, the potency and promise of all terrestrial life." I should prefer to reverse the apothegm, and to say that in life I see the promise and potency of all forms of matter.

In old Egyptian days a well-known inscription was carved over the portal of the temple of Isis: "I am whatever hath been, is, or ever will be; and my veil no man hath yet lifted." Not thus do modern seekers after truth confront nature—the word that stands for the baffling mysteries of the universe. Steadily, unflinchingly, we strive to pierce the inmost heart of Nature, from what she is to reconstruct what she has been, and to prophesy what she yet shall be. Veil after veil we have lifted, and her face grows more beautiful, august and wonderful, with every barrier that is withdrawn.

William Crookes.

RECENT ADVANCES IN MALACOLOGY.

We have received lately, though the work has been some time issued, the second Lieferung of Bergh's Malacological Researches on the collections made by Semper in the Philippines.* The fasciculus in question treats of the *Pleurobranchidæ* in the masterly manner and with all the wealth of anatomical detail and illustration which this author has taught us to expect from him. The text is devoted to an exhaustive anatomical account of *Oscanius*, beginning with the Mediterranean type *O. membranaceus*, *Oscaniopsis* and *Oscaniella* Bergh, new genera, the first exclusively Indo-chinese and the second chiefly so, but having one Antillean representative. The plates include full data on two species of the eastern United States, *Pleurobranchæa tarda* Verrill and *P. obesa* Verrill, the genus *Koonsia*, originally proposed for the latter, being regarded as identical with *Pleurobranchæa* by Bergh.

A very full and useful monograph of the *Dreissensüdæ* of the Palæarctic region has been published by N. Andrusov in the Russian language,† the plates of which have

* Reisen im Archipel der Philippinen von C. Semper. Bd. VII., IVte Abth. Die Pleurobranchiden von Dr. Rudolph Bergh, Wiesbaden, 1897.

†Travaux de la Soc. des Naturalistes de St. Petersbourg. Sect. Géol. et Min., Vol. XXV., 4to, 1898, avec 20 planches phot.

been distributed with an octavo *résumé* of 115 pages in German. In the recent fauna *Dreissensia* is confined to Europe and western Asia, while *Congeria* is distributed in west Africa and the tropical and sub-tropical regions of America. This is curious, since fossil Congerias are extremely abundant in some of the Tertiaries of eastern Europe. A small area in Farther India produces mollusks not distinguishable by the shell from *Dreissensia*, but which our author suspects are different anatomically and refers to as pseudo-*Dreissensia*. Notwithstanding the abundance of *Dreissensia* in Europe and of *Congeria* almost under the shadow of the Johns Hopkins University, a complete account of the anatomy is stlll a desideratum, while the imperfect data recorded have given rise to the most diverse hypotheses as to the relations of this family, of which by far the larger number of species are only known in a fossil state.

Although somewhat belated, notice should be taken of a magnificent contribution to the paleontology of the Alpine Trias by A. Bittner.* This work is devoted to the Pelecypoda of St. Cassian, covering fifty-six genera, of which ten are newly instituted. One of these, *Arcoptera* Bittner, bears a name which has already been used by Heilprin for a Pliocene fossil.† The later genus is based on two very elegant little species of *Arcacea*, and we would suggest that the preoccupied name be replaced by *Bittnerella*. The fauna is one of classic interest, and is illustrated lavishly by admirable lithographic plates.

The current volume of the *Journal de Conchyliologie* contains an important article by H. Fischer, summarizing the works of the late Dr. Felix Bernard on the development of the shell in *Pelecypoda*.* The premature decease of this promising and estimable student came as a shock to those who had admired and profited by his excellent researches. While one might feel disinclined to accept in their entirety the theories he based upon them, the collection of new facts relating to the development of the hinge in Pelecypods is a solid contribution to science for which we shall always be in his debt, while his excellent anatomical papers have met general commendation. Dr. Fischer's summary, in default of the general work contemplated by Bernard, will possess a permanent value.

In this connection we may express our regret at the death of the veteran M. Hippolyte Crosse, senior editor of the *Journal*, to which he devoted many years of conscientious and conservative attention. M. Crosse had attained the age of 71 years, and died on the 7th of August last, followed five days later by Bernard, in the 35th year of his age—two most regrettable losses for French malacology.

We are informed, though it has not yet come to hand, that an index to the last twenty volumes of the *Journal* has been issued, which will be indispensable to all students of mollusks, recent or fossil. We trust that the editorial staff will in future do away with the inconvenient practice of antedating the issues of the *Journal*, which has gradually come about of late years through the delay in publishing some of the numbers. The volume for 1897 (largely issued in 1898), besides the paper above mentioned, includes interesting data on the genus *Cypræa* in the Mediterranean, by the Marquis de Monterosato; on minute shells from the New Caledonian Archipelago, by the R. P. J. Hervier, and on the Quaternary fossil shells collected by M. Piette in the cave of Mas d'Azil (Ariège), by Dr. H. Fischer.

*Revision des Lamellibranchiaten von Sct. Cassian. Abh. K. K. Geol. Reichsanst. Bd. XVIII., Heft. 1, 236 pp., 24 pl., 4to.

†Trans. Wagner Inst. Sci., Philadelphia, Vol. 1, 1885.

**Journ. de Conchyl.*, Vol. XLV., No. 4, pp. 209–224, 1898.

The last number of the Proceedings of the Malacological Society* contains several articles of more than average interest. The anatomy of *Mülleria* has long been a desideratum and the typical Columbian species *M. lobata* is still undescribed. Very unexpectedly a second species turned up in southern India, and from specimens of this form M. F. Woodward has been able to give a very complete account of its anatomical features. It is known that in the young the usual anterior adductor of Pelecypods is developed, but the creature soon becomes sessile and the adult shell presents a remarkable resemblance to an oyster and, like the oyster, preserves only its posterior adductor. The gills are normal, reticulate, and so attached to the mantle as to separate the anal and branchial chambers; but the margins of the mantle remain free. The foot is entirely abortive, but the pedal ganglia remain; the rectum is entirely free from the pericardium and heart, and there is no provision for a branchial marsupium, as in the Naiades. On the whole the characters support the opinion previously based upon the shell, that *Mülleria* is related to the Naiades, but presents extreme modifications due to the sessile habit.

In the same number (pp. 85, 86) Dall gives an account of the macroscopic anatomy of the two peculiar New Zealand genera, *Resania* and *Zenatia*, Gray; of which nothing was previously known. Their relationship to the *Mactracea* is established. In *Resania* the anal and branchial chambers are separated (as in *Verticordia*) by a fleshy septum independent of the gills, and the ctenidia in five adult specimens agreed in being asymmetrical and in having the pendant laminæ on the left side discontinuous longitudinally, the anterior portion being separated from the posterior by a vacant space.

We have also (pp. 94–104) a discussion of the classification of the slugs of the family *Arionidæ* by Professor H. A. Pilsbry, preceded by an account of the anatomy of *Anadenus* and notes on *Geomalacus*. He finds the modifications of the free muscles most fundamental in this group. Geographically the family occupies three widely separated areas which have no common genera. The most primitive forms are American, and an American origin for the family is regarded as probable. Their phylogenetic tree is supposed to have its roots in the *Endodontidæ* and its culmination in the genus *Arion*. *Binneya* is regarded as a connecting link with the *Endodontidæ*, and the family may have spread to Asia by way of an Alaskan land connection.

One of the most interesting recent contributions to malacology is that on the freshwater mollusks of Celebes by the brothers Sarasin.* In the heart of the island, amid high mountains, is the large Lake Passo, lying in a depression of ancient non-volcanic rocks. Close to its shores, covered with a moderate depth of water, is a sandy border which descends abruptly into much deeper water, which has a muddy bottom. On the sandy terrace live many fresh-water shells, and the beaches are abundantly strewn with them. Other lakes have a not very different shell fauna, but in Lake Passo was found the curious Limnæid genus *Miratesta*, one of the prizes of the expedition. The shell is heavy and sinistral, with coarse sculpture, and the animal possesses a large and well developed gill and a peculiarly muscular buccal mass. The dentition is close to that of *Limnæa* and *Isidora*. The latter genus also occurs, and the authors show that *Pulmobranchia* Pelseneer (as pointed out in this Journal, N. S., IV., p. 772, 1896), is synonymous with *Isidora* Ehrenberg (*Ameria*

*Vol. III., No. 2, July, 1898, pp. 63–110.

* Die Süsswasser-mollusken von Celebes, von Drs. Paul and Fritz Sarasin. Wiesbaden, C. W. Kreidel. 1898. VIII., 104 pp., 13 pl., 4to.

H. Adams), which has as one of its characters a more or less completely developed gill. A new genus of the patelliform Limnæids, *Protancylus*, from the lakes of Celebes differs by the same character from the Palæarctic *Ancylus*. The authors suggest that these facts indicate that these forms retain ancient characters belonging to a time when the fresh-water Pulmonates were less differentiated from the marine Opisthobranchiates than at present. Welcome details are also given of the opercula and radula of various Melanians and *Viviparidæ*. There are a few *Neritinæ*, two *Corbiculæ* and a species of *Batissa*, but one of the curiosities of the Celebes fauna is the absence of Naiades, though the latter occur both east and west of Celebes, in Borneo and Australasia.

WM. H. DALL.

AN INSTANCE OF LOCAL TEMPERATURE CONTROL OF THE DISTRIBUTION OF MAMMALS.

IT is a well-known fact that boreal mammals, such as lemmings (*Synaptomys*), red-backed mice (*Evotomys*) and long-tailed shrews (*Sorex*), are found locally in cool situations far to the south of their normal range. The faunal status of the species is thus in no way altered, however; for the occurrence of an animal beyond its usual geographic limits does not prove that the species can defy the influences of climate.

While every life zone undoubtedly has its outlying islands, perhaps the best-known instances of the phenomenon are the small boreal areas scattered through the transition zone and northern part of the upper austral zone in the eastern United States. Many of the 'boreal islands' are found on mountain tops, where their presence is readily explained by the low temperature of high elevations, but others occur practically at sea level, or at an altitude much below that normally attained by the zone in which they lie. Good descriptions of 'islands' of this kind have been recently published by Mr. Vernon Bailey and Mr. Chas F. Batchelder. Mr. Bailey calls attention to 'Tamarack Swamps as Boreal Islands,'* and mentions the fact that the layer of sphagnum with which these swamps are generally carpeted acts as a cooling agent, partly by protecting the ice which during the winter forms beneath it, and partly by inducing evaporation, by which the air at the surface is continually cooled. He found many 'islands' of this kind in the upper austral zone near Ann Arbor, Michigan. Mr. Batchelder describes the cold rock slides in which the Hudsonian *Microtus chrotorrhinus* occurs in the Canadian zone of the Adirondacks, and the swamps that afford the Canadian *Evotomys gapperi* a congenial home in the transition zone of southern New England.† The so called 'rock vole,' *Microtus chrotorrhinus* was found in Essex County, New York, on "a steep hillside heavily wooded with an old mixed growth. The lower slopes were made up of a talus of large angular blocks of rocks piled one upon another as they had fallen from the cliffs above. The damp rocks were covered with sphagnum and ferns, and from the holes and spaces between them came currents of cold air, indicating the presence of masses of yet [August 29] unmelted ice somewhere in the depths below." Of *Evotomys* in southeastern New England he says: "One may look for it with some confidence in almost any large tract of wet ground that retains its moisture through the summer, but is not subject to serious floods, and which bears a growth of woods sufficiently heavy to afford it dense shade, so that the ground beneath and the roots of the trees are covered with a deep carpet of sphagnum. * *

*SCIENCE, N. S., III., p. 250, February 14, 1896.

†Proc. Boston Soc. Nat. Hist., XXVII., pp, 188 and 192–193, October, 1896.

* * One of the most evident peculiarities of such a spot as this, in southern New England, is that the dense shade and abundant evaporation maintain a temperature during the hottest summer weather that is far below that of the surrounding country. In these aspects of coolness, moisture and shade there is a striking resemblance to the woods *Evotomys gapperi* inhabits in extreme northern New England and other parts of the Canadian zone." These accounts, interesting and suggestive as they are, give no clue to the exactness of correspondence between the temperature of the southern boreal islands and that of the main northern part of the boreal zone. So far as I am aware, no attempt to correlate the two has yet been published.

During the summer of 1897 I had the opportunity to make some approximately exact observations on the relative temperatures of a 'boreal island' and the immediately contiguous upper austral zone in the bottom of Fort Valley, at the north end of Massanutten Mountain, Warren County, Virginia. The locality was so inaccessible —to reach it and return necessitated a drive of nearly twenty miles—that only a small part of the day could be spent in making observations, and my instruments were merely cheap thermometers bought at a country store; but, in spite of these obstacles in the way of completeness and accuracy, the results are sufficiently positive to show how important a field is open for similar work done under favorable conditions and with accurate instruments.

Fort Valley lies between two parallel ranges of low mountains, extending nearly north and south, between the forks of the Shenandoah River. Its eastern side is formed by the abrupt, regular, western slope of Massanutten Mountain. On its western side the slope is less precipitous, and the mountain chain is much broken into separate peaks and irregular ridges. At its point of opening into the broad level Shenandoah Valley, two miles south of the railroad station of Waterlick, Fort Valley is narrowed to a mere pass, scarcely wide enough to allow the exit of a small stream, Passage Creek, and a wagon road. At this point the bottom of Fort Valley is only about 750 feet above sea-level, and scarcely 200 feet above the nearest point on the Shenandoah River. On the east Massanutten Mountain rises to an elevation of some 1,800 feet, and on the west Three Top Mountain barely reaches 2,300 feet. Just here the west slope of Massanutten Mountain is unusually precipitous. For several hundred feet below the summit the face of the mountain is a sheer, bare cliff; below this a rough talus slopes abruptly to the edge of Passage Creek.

The upper austral flora of the Shenandoah Valley passes uninterruptedly over these low mountains and through Fort Valley. Near the mouth of the Fort a few characteristic species, such as the pawpaw and persimmon, both of which are very common immediately outside, disappear, but this is evidently due to lack of congenial soil, as both grow at much greater heights on the neighboring mountains. A fine growth of hemlock gives the place a somewhat un-austral aspect, but these trees are freely interspersed with gums (*Nyssa*), three-leaved hop trees (*Ptelea*), fringe trees (*Chionanthus*), tulip trees (*Liriodendron*) and southern bass woods (*Tilia pubescens*)—a typical austral assemblage.

The mammal fauna outside of the 'boreal islands' showed no peculiarities. It was simply that of the upper austral zone, and it extended wherever I trapped on the mountains as well as in the valleys. Among the hills on the west side of Fort Valley are a few small cold streams, and on the banks of these I secured two boreal mammals, a red-backed mouse (*Evotomys carolinensis*) and a shrew (*Sorex fumeus*). The nearest points from which the former has been recorded are Roan Mountain, North Caro-

lina,* altitude 6,000 feet, and Travellers' Repose, West Virginia,* altitude about 3,000 feet. The shrew is recorded from Roan Mountain† and from the higher mountains of central Pennsylvania.‡ Both of these animals occurred also in considerable numbers among the loose rocks of the talus at the narrowest part of Fort Valley, altitude 750 feet.§ This boreal colony was completely surrounded by the upper austral fauna, which extended more than a thousand feet above it. The mammal fauna of the talus slope was not made up exclusively of these two species. As might be expected, such abundant, freely roaming austral forms as the wood rat (*Neotoma pennsylvanica*), white-footed mouse (*Peromyscus leucopus leucopus*), and chipmunk (*Tamias striatus striatus*), were often caught in traps set among the loose rock masses. These common species would naturally wander from the woods over the comparatively small area of the rock slide in search of food. A single short-tailed shrew (*Blarina brevicauda*) was taken there also. This animal, however,ranges freely into the boreal zone.‖

As I have already said, the talus sloped abruptly to the edge of Passage Creek. It was in no way peculiar, but had all the well-known characteristics of such formations. It supported a very scant tree growth. The rock fragments were overgrown with lichens, and in protected places there were large mats of moss and ferns, but I found no sphagnum. At the point where my temperature observations were made, a widely open cavity had been formed beneath some unusually large rock fragments held from slipping downward by the roots of trees. From this cavity at the base of the talus, as well as from smaller ones on its sides, there was a constant outpour of cold, damp air. This was especially noticeable on hot, still days, when the air currents kept the ferns about the mouths of the crevices continually waving, while all other vegetation was motionless. From the large cavity to the edge of the water was a distance of about ten feet. The rocky bed of the stream at this point was only some twenty feet wide. On the opposite side of the stream was a flood-plain, perhaps twenty yards across. It was very irregular in surface, and consisted merely of masses of sand brought down from the valley above during freshets and lodged among the rocks. The flood-plain was well wooded, first with a fringe of shrubs and further back from the stream bed with a vigorous growth of trees, such as I have already described. Beyond the flood-plain rose the gradual slope of Three Top Mountain. Although parts of the flood-plain afforded what appeared to be perfect shelter for red-backed mice and smoky shrews, the most careful trapping failed to bring to light anything but the common upper austral mammals. Colonies of pine mice (*Microtus pinetorum*) occupied places that were sufficiently sandy, and white-footed mice abounded. I also detected the work of a mole which appeared to be that of *Scalops aquaticus*. It is safe to say that at this point the typical boreal species were strictly confined to the talus, the more sedentary austral forms to the flood-plain and warm mountain sides, but that the more active and abundant austral species wandered freely in search of food.

For temperature observations I established four stations. Station 1 was on the flood-plain at the base of Three Top Moun-

* Bailey, Proc. Biolog. Soc. Washington, XI., p. 130, May 13, 1897.

† Merriam, North American Fauna, No. 10, p. 66, December 31, 1895.

‡ Rhoads, Proc. Acad. Nat. Sci., Philadelphia, 1897, p. 223, May, 1897.

§ The altitudes of localities in this region are from the Luray sheet of the United States Geological Survey Topographic Map.

‖ See Miller, Proc. Boston Soc. Nat. Hist., XXVIII., p 38, April 30, 1897.

tain; station 2 was a few yards back from the edge of the stream directly opposite the large cavity in the talus; station 3 was at the water's edge on the opposite side of the stream from station 2, and station 4 was in the cavity at the foot of the talus. At each station the thermometers were placed on the surface of the ground in positions where they would be protected from all direct rays of the sun, and so far as possible from any influence of reflected heat. The conditions at station 4 were somewhat exceptional, but even here the thermometer was not placed under ground, but on the surface of the rocks beneath the overhanging roof of the widely open cavity. The detailed results of the readings are given the following table:

Date 1897	Hour P. M.	Station. 1	2	3	4	Water.	Sky.
Aug. 20.	1.20	72.5°				69°	Sl'tly cloudy
" "	2.15		**67°**	64°	**58°**		" "
" "	2.40			63°	**57°**		" "
" "	2.50			68°	**59°**		
" "	3.40			66°			Clouds hea'y
" "	4.00			66°	**59°**		" "
" "	4.30	70°					" "
" 22	1 00	75.5°					" thin
" "	1.30		**72°**		**59°**	72°	" "
" "	2.50		**72°**				Almost clear
" "	3.10		**72°**				Clear
" "	3.50				**61°**		"
" "	4.20	75°					Clouds thin
" 24	12.45	69°					" "
" "	1.30	71°	**70°**			66°	Clear
" "	2.15		**70°**		**60°**		
" "	3.40		**68°**		**60°**		
" 30	1.30	77°				71°	Clouds dense
" "	2 20		**79°**		**58°**		" thin
" "	3.45		**72°**		**58°**		" dense
Sept. 1	2.00	74°				73°	Clear
" "	2.30		**77°**		**58°**		"
" "	3.30				**58°**		"
" "	3.40		**74°**		**58°**		"
" 5	2.30			67°			"
" "	3.20		**75°**		**54°**		"
" "	4.00					70°	"
" 7	1.10	88°					"
" "	2.45		**80°**	63°			"
" "	3.00				**56°**	70°	"
" "	5.40		**74°**		**56°**		"
" 9	5.00		**79°**	66°			"
" "	5.10				**56°**		"
" "	5.45		**76°**				"
" 11	3.00		**80°**	67°		73°	"
" "	3.40		**80°**		**57°**		"
" "	5.30		**74°**		**57°**		"
" 13	3.00			67°		73°	"
" "	3.30		**79°**		**58°**		"
" "	4.20				**58°**		"
" "	5.30		**78°**		**58°**		"
Mean.		74.6°	75°	65.7°	57.8°	70.7°	"

The readings at stations 2 and 4, being the most important to compare, are printed in heavy type. It is to be remembered that these two stations were less than fifty feet apart.

On comparing the means of the readings at stations 2 and 4 it is seen that the boreal mammals lived in an atmosphere the mean temperature of which, during the afternoon, at nearly the hottest part of the summer, was about 17° lower than that of the region occupied by the upper austral fauna. How this relationship might be altered by including observations taken throughout the day and night can only be guessed at, but I think it would remain essentially the same. The question next arises as to how nearly the means of 75° and 58° correspond with the known means, for the same season, of the upper austral zone and boreal zone respectively. Turning to the only published table of zone temperatures* we find that the range of normal mean temperature of the six hottest consecutive weeks at extreme northern and southern localities in the two zones is as follows: upper austral, 71° to 78°; boreal (Canadian), 57° to 64°. In each case, therefore, the mean temperature of the station coincided with that of the life zone to which the fauna of the station belonged.

Gerrit S. Miller, Jr.
U. S. National Museum.

*Merriam, Laws of Temperature Control of the Geographic Distribution of Terrestrial Animals and Plants. *The National Geographic Magazine*, VI., pp. 229–238, December, 1894.

THE ANNUAL INSPECTION OF THE PRIBILOF SEAL ROOKERIES.

In compliance with the Act of Congress of 1893, the U. S. Fish Commission has each year made an investigation respecting the condition of seal life on the Pribilof Islands.

This work, usually performed in connection with former duties on the steamer *Albatross*, was officially resumed by the writer during the past season in connection with the work of the Division of Fisheries.

Owing to the continuance of pelagic sealing the seals are still diminishing in numbers, and the seal catch on land and sea grows less from year to year. The percentage of decrease in the number of seals born on the islands becomes more noticeable as time passes, the operations of the sealing fleet producing a more marked effect on the reduced herd; in 1897 there was found a decrease of 11 per cent. over the preceding year, and during the present season a decrease of 22 per cent. since 1897. The decrease is best shown in the annual counts of seals born on all rookeries small enough to admit of counts being made. These rookeries were, with one exception, on St. Paul Island. A year ago it was not considered feasible to extend the census of pups to any additional rookeries on account of their size. This year it was found that all the rookeries on St. George Island had shrunken to such a degree that actual counts could be substituted for the various estimates hitherto employed. These counts, in connection with those made regularly on St. Paul Island, will be very useful hereafter. Since 1896 the land catch has been: 1896, 28,964; 1897, 20,890; 1898, 18,032. The pelagic catch has decreased as follows: 1894, 61,838; 1895, 56,291; 1896, 43,917; 1897, 24,322. The pelagic catch for 1898 has not yet been made known; but whether less than in 1897 or not, there is no uncertainty about the diminution of the herd.

On account of temporary difficulties, the fences built for retaining males on land were not as strong as they should have been, and many seals escaped. There will be little difficulty in making them perfect next season. Fencing is practicable, and serves the double purpose of preventing the laborious re-driving of non-killables, and keeping them at home during the presence of the sealing fleet in Bering Sea.

Some of the females branded, for the purpose of lessening the value of their skins, were seen, but young females are not conspicuous about the islands in midsummer.

Certain smooth rookery grounds have been covered with boulders to afford young pups shelter during the battles of the bulls, and attempts will probably be made to repair the injurious worm-infested areas.

A rational scheme of seal ranching is being developed that will practically do away with the moderate natural mortality, and facilitate such handling of the animals as is necessary. Of course, no care of the seals on the breeding grounds will save them, should pelagic sealing continue. The nucleus remaining is sufficiently strong to restore the herd in a few years.

C. H. TOWNSEND.

U. S. FISH COMMISSION.

THE NATURAL HISTORY MUSEUMS OF BRITISH COLUMBIA.

IN proportion to the population and total number of educational institutions, British Columbia has an unusual number of natural history museums. These are exceptionally well administered, considering their isolation from other scientific institutions.

The Provincial Museum at Victoria is by far the most important one in the Province. It is located in the east wing of the Parliament Building, thus having the facilities of the Parliamentary Library. The staff consists of the curator, Mr. John Fannin, a taxidermist and two floor attendants. The Museum was originated some years ago by the government, at the suggestion of Mr. Fannin, whose private collection formed the nucleus of the Museum, after having been the stimulus for its foundation.

As Mr. Fannin's special interest lies in the fauna of the Province, to the knowledge of which he has made important contributions, the trend of the Museum is in this direction, although the other departments of natural history are by no means neglected.

Special attention is now being given to

the building of groups of birds and mammals represented in their natural environments. The interest of the people in this work may be gauged from the fact that Mr. Fannin was sent to the great museums of England and the eastern United States to investigate the methods of preparing such groups.

The policy of the Museum is to be mainly provincial and, while specimens from all parts of the world are used for comparison, the endeavor is thoroughly to represent the natural history of the Province, so that visitors from foreign countries may see at a glance the natural treasures of the region. The collection contains good representation of the birds and mammals of the Province. At present efforts are being made to improve the mountings and secure better specimens of the species.

Fish are represented by gelatine casts and alcoholic specimens. The value of the collection will soon be in proportion to the importance of the fisheries of their coast. There are some specimens illustrating osteology. A considerable collection of crustaceans and shells is also on exhibition, as well as a beautiful series of butterflies and other insects.

This rich mining region is naturally productive of fine mineral specimens, which are represented in the Museum, together with the paleontological collections. Although the Province is excessively rich in anthropological material, its representation in the Museum has been somewhat curtailed from lack of funds. However, there is a fair collection of casts of faces of men; stone, bone and antler implements from shell heaps and mounds; several totem poles, carvings and other ethnological material from the Indian villages of the coast. The implements of hunting and the chase are classed together, as are also the specimens connected with fishing, houses and property, travel, religion, etc.

The Museum is fairly well arranged, and the labeling will put to shame many of the great museums of the East, although, as with all such institutions, constant improvements are being made.

The city of Vancouver, with a population of some twenty thousand, seems too young to show much interest in the museum as a natural adjunct to education, although the Art and Scientific Society is endeavoring to form a museum in its rooms.

New Westminster, with a population of eight thousand, has made a splendid beginning towards a museum properly connected with other educational affairs. The upper story of the City Library has been set aside for museum purposes.* Cases have been built from plans furnished by the Smithsonian Institution, and space has been allotted for the various divisions of natural history. There has already been secured and installed a considerable collection of birds and small mammals. Many of these were donated by the Provincial Museum. Several cases have been filled with minerals and other geological specimens. A very few ethnological specimens have been secured; there is more material of an archæological nature. Some of the stone and bone implements represent rare forms.

The spirit of museum administration exhibited at these institutions is one to be commended. There seems to be no thought in mind to conflict with the plan that the collections are intended for study. Every facility is given to visitors to examine, illustrate or publish papers on any of the material within the museums. It is also understood that full labels are desired. In fact, the spirit shown in these museums is one in close cooperation with research and education.

Harlan I. Smith.

American Museum of Natural History,
New York.

* The Library and Natural History Museum of New Westminster were totally destroyed by the fire which consumed that city on September 11, 1898.

ZOOLOGICAL BIBLIOGRAPHY AND PUBLICATION.*

THE report presented in 1896 stated that this Committee was issuing two circulars: (I.) Questions concerning general principles of Bibliography and Publication, sent to experts and leading zoologists; (II.) Suggestions concerning various cognate matters 'wholly within the control of editors and publishing committees,' sent to the editors of all publications connected with zoology.

Circular I. has been sent to 115 zoologists, the majority of whom have had practical experience in bibliography. From 36 of these, in various parts of the world, replies have been received, containing, in many cases, a detailed discussion and practical suggestions of much value. A digest of these replies is being drawn up, and the Committee hopes to furnish a definite report thereon next year. Meanwhile certain of the suggestions and criticisms received have greatly helped the Committee in its consideration of the replies to Circular II.

To this latter circular and its strictly practical proposals the Committee thinks it advisable to confine attention for the present. Circular II. has been sent to the editors of nearly all the publications listed in the *Zoological Record*, viz., to some 800, the exceptions being those whose addresses could not be ascertained; it has also been sent to the editors of various publications not hitherto included in the *Zoological Record* list, *e. g.*, all zoological publications recently started.

Replies were not specially solicited, but comments have been received from 39 editors or publishing bodies, to all of whom the Committee desires to express its thanks. Among them may be mentioned: the R. Physical Society of Edinburgh, the Natural History Society of Glasgow, the Cambridge Philosophical Society, the Entomological Society of London, the Liverpool Biological Society; *Nature*, *Natural Science*, *The Zoologist*, *The Entomologist*, *The Journal of Malacology*, *Journal of Physiology*, Cambridge; The R. Asiatic Society, Ceylon Branch; K. Akademie der Wissenschaften zu Berlin; K. Zool. u. Anthrop.-Ethnogr. Museum zu Dresden; Zoological Station in Naples; R. Soc. Scientiarum Bohemica; Physikalisch-ökonomische Gesellschaft zu Königsberg; R. Soc. Sciences in Upsala; Société Impériale des Naturalistes de Moscou; Koninklijke Akademie van Wetenschappen, Amsterdam; Geological Society of America, Philadelphia Academy of Natural Sciences, Essex Institute, Cincinnati Society of Natural History, Natural History Society of New Brunswick, SCIENCE, *Bulletin of American Palæontology*, *Entomological News*. All these replies are favorable to the suggestions of the Committee in the main, and some even ask for further advice. Exception has, however, been taken by some to suggestions 1, 3 and 7; while comments have also been made on suggestions 2, 4 and 5. It is proposed to deal with these in order.

First, the Committee wishes to state clearly that it has no wish, even if it had the authority, to lay down laws for zoologists or for publishing bodies and editors. It is, however, plain that many are grateful for some guidance, and the Committee hopes that it may serve as a medium for conveying to those who need it the general opinion of the experienced. They are also difficulties which, though they appear to some insuperable, may possibly be surmounted in ways that have been communicated to the Committee.

(1) "That each part of a serial publication should have the date of actual publication, as near as may be, printed on the wrapper, and, when possible, on the last sheet sent to press."

*Second report of the committee consisting of Sir W. H. Flower, chairman; Professor W. A. Herdman, Mr. W. E. Hoyle, Dr. P. L. Sclater, Mr. Adam Sedgwick, Dr. D. Sharp, Mr. C. D. Sherborn, Rev. T. R. R. Stebbing, Professor W. F. R. Weldon and Mr. F. A. Rather, secretary.

Five correspondents do not see the use of this, thinking that the date on the wrapper is enough, and that in the case of annual publications the date of the year suffices. The Committee would point out that wrappers are constantly lost in binding, and that periodicals are often broken up by specialists or second-hand booksellers, the consequent loss of date causing much trouble to workers of a later day. To avoid this, the Cincinnati Society of Natural History would add the date at the head of each paper, while *Natural Science* prints the month and year across every page-opening. Some societies, *e. g.*, the Philadelphia Academy, issue a certificate of dates at the end of the volume. The Liverpool Biological Society 'put at the head of each paper the date when it is read, and are willing to add the date when it is printed off;' neither of these dates are necessary, and they may be misleading. In most cases the actual day of publication is immaterial, especially in cases where no new species are described, but at least the month should always be given, and the Committee does not see that there need be any difficulty in doing this. If some unforseen delay does occur, the date can always be rectified with a date-stamp.

(2) "That authors' separate copies should be issued with the original pagination and plate-numbers clearly indicated on each page and plate, and with a reference to the original place of publication."

The Committee believes this to be a most important recommendation, and its view is supported by all the zoologists consulted. Nevertheless, many leading publications continue to issue authors' copies repaged, and often without reference to volume-number, date, or even the name of the periodical. The remedy is so simple that the Committee urgently appeals for its universal application.

(3) "That authors' separate copies should not be distributed privately before the paper has been published in the regular manner."

It is a curious fact that on this question editors take a different line to working zoologists. All the latter who have discussed the matter agree with the Committee as to the extreme inconvenience caused by the general custom. Among the editors, however, nine (*i. e.*, nearly one-quarter) protest against the present recommendation. The objectors represent small societies which publish at lengthy intervals, and their reasons are: that it is not fair to an author to prevent him from receiving his separate copies for perhaps a year; that it is not to the advantage of science that work should thus be delayed; that a society which did this would receive fewer contributions and lose its members. In brief, the argument is: "We are too poor to publish properly; therefore, we must allow authors to publish improperly." This form of argument suggests an easy remedy, and one that, on the informal suggestion of the Committee, has already been put into practice by the Liverpool Biological Society and by the R. Physical Society of Edinburgh. The remedy is this:

In cases where a volume or part can only appear at long intervals each author that requires separate copies of his paper for private distribution before its publication in the volume or part should be permitted them only on this condition—that, for every month before the probable issue of the volume, a certain number of copies—say five—should be placed by him in the hands of the society or its accredited publisher, in order that they may be offered for sale to the public at a fixed price. Further, that the society, for its part, should announce the publication, with price and agent, of their papers to some recognized office, or to some such paper as the *Zoologischer Anzeiger*. The details of expense must be settled between the author and the society.

(4) "That it is desirable to express the subject of one's paper in its title, while keeping the title as concise as possible."

It is satisfactory to find no objections raised to this recommendation, since there is no doubt that there is room for much improvement in this direction. Such phrases as 'Further contributions towards our knowledge of the * * * * ,' or 'Einige Beobachtungen über * * * * ,' or 'Essai d'une monographie du genre * * * * ' might well be dispensed with as superfluous. The ornithologist who, in 1895, published a book with a title of ninety-one words would seem to have forgotten the functions of a preface.

On the other hand, it is pointed out that certain periodicals, such as the *Bulletin de la Société Entomologique de France* and the *Sitzungsberichte der Gesellschaft naturforschender Freunde zu Berlin*, publish communications without any title, to the constant confusion of naturalists. The Committee begs to urge the reform of this practice, in which it can see no advantage.

(5) "That new species should be properly diagnosed, and figured when possible."

The only comment on this is the proposed omission of the words 'when possible.' With this the Committee sympathizes, but wishes to avoid all appearance of laying down a law that would constantly be broken.

(6) "That new names should not be proposed in irrelevant footnotes or anonymous paragraphs."

Naturally nobody supports such actions as are here objected to, but since some have doubted the possibility of the latter, it is as well to state that the suggestion was based on an actual case occurring in the Report of a well-known International Congress. The proposal of a new name, without diagnosis, in a footnote to a student's text-book, or in a short review of a work by another author, is by no means a rare occurrence. The Committee believes that such practices are calculated to throw nomenclature into confusion rather than to advance science.

(7) "That references to previous publications should be made fully and correctly if possible, in accordance with one of the recognized sets of rules for quotation, such as that recently adopted by the French Zoological Society."

Dr. Paul Mayer, of Naples, writes: "Most authors are extremely idle in making good lists of literature themselves, and even opposed my correcting them according to our rules. There ought to be some training in this at our universities." This is confirmed by one or two other editors, but not all have the energy of Dr. Mayer. Some, indeed, oppose the word 'fully' on the ground that it leads to waste of time and space. The Committee would explain that the reference to a particular set of rules was intended merely as a guide to those who have not had the training that Dr. Mayer would like to see; they would also point out, in the words of the editor of the Cincinnati Society of Natural History, that 'what may be intelligible to the specialist is very puzzling to the general student.' Nowadays, when so many zoologists work with the aid of authors' separate copies, it is an enormous convenience to them to have the title of the paper at least indicated, and not merely the volume, date and pagination given. The Committee, therefore, cannot agree that this suggestion involves a waste of time.

ASTRONOMICAL NOTES.

SECTION A AT THE BOSTON MEETING, A. A. A. S.

IT might be thought that the meetings of the Astronomical Conference and of the Mathematical Society, which preceded that of the American Association and were prolonged so as to interfere somewhat with it, would have detracted from the interest in Section A. While this may have been true in part, it did not reduce the number of the

papers nor their excellence. Forty papers were offered, of which twenty-six were read in full. As two days only were given to meetings for the reading of papers, a subsection was organized on the second day, to which were referred the papers in abstract mathematics. There were also four valuable reports on recent progress, two of which were read before the mathematical subsection and two before a joint session of Sections A and B.

Of the strictly astronomical papers, three were concerned with the teaching of the science; two each with subjects relating to stellar positions, to the work of observatories and to the study of planetary details; and one each with the subjects of photometry, personal equation, variation of latitude and solar eclipses. The short time allowed for these papers, which were all of interest and without exception well presented, prevented their discussion, as there was a perceptible feeling of hurry due to the desire to complete the program. This lack of discussion is to be lamented in scientific gatherings. Fortunately it did not exist at the Conference at Cambridge, where the discussions called out by the papers were a marked feature.

THE ASTEROID DQ.

The discovery by Herr Witt at Berlin, August 13th, of a minor planet whose mean distance from the sun places it between the Earth and Mars is of great interest. It was detected by photography and given especial attention because of its rapid motion. Provisional elements were calculated by Herr Berberich, who has made a specialty of asteroid orbits, and were published in the *Astronomische Nachrichten*. The observations made since their publication show but small departures from the calculated positions, and confirm the substantial accuracy of the provisional orbit. Mr. A. C. D. Crommelin, of the Greenwich Observatory, published in the *Observatory* for October the results of calculations which assume the accuracy of the first orbit, but which can probably be relied on. As the perihelion distance is 1.13 and the eccentricity 0.23, the least distance of the planet from the Earth is 0.15 (about 14,000,000 miles), while that of Venus is 0.27 and of Mars 0.38. The planet, therefore, comes nearer the Earth than any other planet except the moon, and can be used with great advantage for observations to determine the solar parallax. Its sidereal period is 644.-734 days and its mean synodic period 2.-30692 years. It is approximately 17 miles in diameter and was of the 7th magnitude in 1894. It is surprising that it has not been detected before, but Mr. Crommelin is of the opinion that it has not been introduced into the system by the action of any other planet (the nearest approach to Jupiter is 3.2), but has always been one of the solar family. It will be interesting to learn if the photographs made so abundantly in recent years at Cambridge and elsewhere do not contain it, and undoubtedly they will be examined when the planet's positions in former times are determined.

The Earth passes the longitude of the planet's perihelion January 22d. The next opposition of the planet comes in November, 1900, the perihelion passage occurring February 12, 1901. The opposition in 1894 was a very favorable one, unfortunately lost; another will come in 1924, but that of 1900 will be sufficiently good to warrant careful observations for the solar parallax. In *Circular 34* of the Harvard College Observatory Professor Pickering gives the results of determinations of its brightness. Mr. Wendell's observations with the visual photometer give the mean 12.13 ± 0.04, which corresponds with the 11.39 at the distance 1. The photographic determination of its brightness is difficult, because an exposure of sufficient length to give any

image at all produces an elongated image, whose intensity is compared with difficulty with the circular stellar image. The photometric magnitude is 12.70 ± 0.08, which implies, when compared with the visual magnitude, that the color of the planet is redder than that of the comparison stars.

Professor Pickering notes that the planet offers opportunity for the examination of several photometric problems:

"First, the approximate diameter may be determined by comparison with the brighter asteroids and satellites, assuming that the reflecting power is the same. Secondly, the great variation in the distance of this object from the earth will afford an excellent test of the law that the light varies inversely as the square of the distance. The existence of an absorbing medium in the solar system will thus be tested. Thirdly, owing to the proximity of this object to the earth at opposition, its phase angle will vary by a large amount. It will, therefore, afford an excellent test of the law connecting this angle with the variation in brightness which has been found by two or three observers independently."

THE ANDROMEDA NEBULA.

SUSPICIONS of change in this nebula have been recently announced, but lack confirmation. Mr. A. A. C. Merlin, British Vice-Consul at Volo, Greece, telegraphed August 29th that a star near the nucleus of the nebula was visible in an 8-inch refractor. This information was not cabled to this country, because observations at Hamburg, Bamberg and Bonn, on August 30th and 31st, failed to confirm the observation. But the *Observatory* for September announced publicly the alleged discovery, and added that observations at Greenwich, August 31st, showed nothing unusual. On September 20th a despatch was sent from Kiel to this country and distributed announcing that "Seraphimoff, of Pulkowa, confirms a stellar condensation in the center of the Nebula in Andromeda." Photographs at Harvard Observatory on September 20th and 21st, when compared with those taken in 1893, 1894, 1895, 1896, failed to confirm the confirmation, and the evidence of the suspected change seems to be decidedly in the negative.

WINSLOW UPTON.

BROWN UNIVERSITY.

ZOOLOGICAL NOTES.

ANOTHER SPECIMEN OF NOTORNIS.

FOURTEEN years ago, in referring to the capture of the third living *Notornis*, the great flightless water-hen of New Zealand, the writer took occasion to remark that "it is by no means impossible that other specimens may be added to the three already known, since the localities at which these were taken were some 90 miles apart in a region little known." This expectation has recently been realized and the capture of a fourth *Notornis* is recorded at some length by a correspondent of the London *Times*. The species was based by Owen on some bones, including an imperfect cranium, collected by Walter Mantell so long ago as 1847, and as the remains were associated with those of *Moas* it was naturally supposed that, like them, *Notornis* was extinct. The discovery of a living bird in 1849 showed that fortunately this supposition was incorrect and that this, the largest member of the Rail family, had escaped being 'eaten off the face of the earth by gluttonous man.' It may be said here that Dr. Meyer, and doubtless correctly, considers the fossil and living species of *Notornis* as distinct species, the former bearing the original name *Notornis mantelli*, while the latter is called *Notornis hochstetteri*.

The first living *Notornis* was taken on the shores of Dusky Bay by some sealers who followed its tracks through a light snow, and a second was caught three years later on

Secretary Island, Thompson Sound. Then followed an interval of twenty-seven years without any reliable record of *Notornis*, and it seemed not improbable that the species had at last become extinct, when a third was captured by a rabbit hunter, or rather by his dog, on the eastern side of Lake Te Anau. This specimen was offered in the United States for $600, and was finally sold at Stevens's famous auction rooms, London, for £110.

The exact locality where the fourth and last bird was found is not given, but it is pretty certain that the species ranges over a considerable extent of wild country and, although probably what may be termed a 'decadent' species, will persist for a while longer.

It is to be hoped that the last specimen has fallen into the hands of some one who will preserve both skin and skeleton, for there is no reason why so large a bird should not be both mounted and skeletonized. The habit of 'keeping the skin and throwing away the characters' of a bird is, however, only too prevalent, and when this is done by professional collecters we can not expect much from others. And this leads to the remark that, when the party dispatched to the Galapagos Islands by Hon. Walter Rothschild obtained four specimens of the flightless and all but extinct cormorant they simply took the skins and failed to preserve a single bone. Considering that the problems of the place of origin and lines of dispersion of the cormorants hinge upon anatomical evidence, such neglect is little less than culpable.

ZOOLOGICAL NOMENCLATURE.

In *The Auk* for October, Mr. D. G. Elliott attacks and Dr. J. A. Allen defends, successfully it seems to us, Canon XL of the Code of the American Ornithologists' Union. This canon states that "the permanence of a name is of far more importance than its signification or structure.* * * It therefore follows that hybrid names [anagrams, 'nonsense' names and 'barbarous' or 'exotic' names] cannot be displaced. * * * " Why any working zoologist, including under this term paleontologists, should wish to abolish this canon it is difficult to understand, for its removal, or lack of adoption, would open, or does open, the way to countless changes of nomenclature and the creation of hundreds, if not thousands, of new names. And all for no good reason; zoological names are not literature, but simply handles by which species may be grasped, and they serve their purpose equally well if rough hewn or grammatically polished. Le Conte used *Gyascutus* as a generic name simply to illustrate the point that a name need not of necessity have any meaning, and Dr. Leidy coined names with the express statement that they were not etymologically correct, but used because they were shorter than if correctly formed. While it is well when proposing a new name to have it properly formed, there is no reason why long-existing names should be overthrown simply because of some fault in their construction. Possibly most of the readers of Science are familiar with Professor Walter Miller's paper on 'Scientific Names of Latin and Greek Construction,' published in the Proceedings of the California Academy of Sciences, but the paper deserves to have a wide circulation. F. A. L.

CURRENT NOTES ON ANTHROPOLOGY.

ANTIQUITIES OF COSTA RICA.

The last report (March, 1898) of Señor Juan F. Ferraz, Director of the National Museum of Costa Rica, presents in succinct form the condition of the institution, its aims, its regulations and its needs. It is earnestly to be hoped that to the latter there will be a liberal response, as the Museum has done excellent work and is a credit to the State of Costa Rica.

Archæology is a branch which the Museum has always cultivated, and it made an honorable display at Madrid and Chicago. In the present report there is appended a lithograph of a remarkable monolithic inscription on the right bank of the Rio Colorado, province of Guanacaste. It displays two well-known conventional signs for 'man' surmounted by what seems to be the drawing of a tomahawk, and above this an elaborate figure, apparently of a house or other building. A photograph and exact measurements would be most desirable and are necessary for a proper study of the monument.

THE BORGIAN CODEX.

THIS valuable relic of ancient Mexican literature, deriving its name from Cardinal Borgia and preserved in the library of the Vatican, has been recently reproduced in fac-simile by the munificence of the Duc de Loubat. The copies are limited in number and most of them have been presented to institutions. The one I have seen is in the library of the Museum of the University of Pennsylvania.

The Codex makes a book $10\frac{1}{4}$ inches square, folded in the usual Mexican manner (like a screen), of 74 pages, and is apparently complete. Its contents appear to be the arrangement of the *tonalamatl*, in various sequences, for divining purposes. The grotesque collections of objects indicate the phonetic element of the picture writing, according to the 'ikonomatic' system.

The reproduction is most carefully executed and offers the student all the advantages of the original document.

A NEWLY-PUBLISHED AZTEC DOCUMENT.

DR. ANTONIO PEÑAFIEL, already well known for his publications on Mexican archæology, has begun the issue of a 'Colecion de Documentos para la Historia Mexicana,' with a reproduction, in colors, of the 'Mexican Manuscript, No. 4,' of the Royal Library of Berlin. It dates from after the Conquest, about 1539, with a text in Nahuatl and Spanish. The colored figures represent the names of places and of persons exhibited by that method of phonetic writing for which I have proposed the term 'ikonomatic' (see my 'Essays of an Americanist,' pp. 213–229). Dr. Peñafiel is not always successful in the analysis of these complex figures. Thus (p. 33) *Tepecoman* was not understood by the native artist as *tepetl*, town, and *comalli*, dish (as Dr. P. says, p. 73), but as *tepetl*, mountain; *co*, in; *maitl*, hand; so he drew the picture to represent a hand in, and coming out of, a mountain.

The publication is of much interest to archæologists, and it is earnestly to be hoped that the erudite editor will continue the series.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

THE NATURALISTS AND AFFILIATED SOCIETIES.

THE program of the American Society of Naturalists to be held in New York on Wednesday and Thursday, December 28th and 29th, is as follows:

December 28th, at the American Museum of Natural History, at 8 p. m. Address of welcome by the President of the Museum, Morris K. Jesup, followed by a lecture on 'Collections of Fossil Mammals and their Care,' by Professor Henry F. Osborn. At 9:30 a reception to the Naturalists and Affiliated Societies, given by Professor Osborn at his house, No. 850 Madison avenue.

December 29th, at Schermerhorn Hall, Columbia University, 12:30–3 p. m., provision will be made for those members who wish to lunch at the University (West Hall). 2. p. m., business meeting of the Naturalists. At 3 the annual discussion on 'Advances in Methods of University Teaching,' by representatives of seven societies, the Anatomists, Anthropologists, Geologists, Botanical Morphologists, Animal Morphologists, Physiologists and Psychologists. At 6:30 an informal session of the Naturalists will be held, pending the annual dinner at 7.

On Friday, December 30th, an opportunity will be given for the members to visit the

Botanical and Zoological Gardens at Bronx Park, New York City. Detailed circulars will shortly be sent out to members by the Secretary of the Naturalists, Dr. H. C. Bumpus, Brown University, Providence, R. I. A local committee has been formed with Professor Osborn, as chairman.

ARRANGEMENTS will at once be made for the meetings of the affiliated societies. It may already be stated that the American Physiological Society and the American Psychological Association will meet on Wednesday, Thursday and Friday, and probably the same days will be chosen for the American Morphological Society, the Society for Plant Morphology and Physiology, and the Association of American Anatomists. The Section of Anthropology of the American Association will meet on Tuesday, followed on Wednesday by the American Folk-lore Society.

THE New York State Science Teachers' Association will, as we have already stated, hold its third annual meeting in New York, in conjunction with the Naturalists, on Thursday and Friday of Christmas week. The opening session will be at 10:30 a. m. on Thursday, and in the afternoon a discussion on science for admission to college will be opened by Professor Davenport, of Harvard University, followed by Professor Bailey, of Cornell University, and other speakers. In the evening the President, Professor Hargitt, of Syracuse University, will make an address, to be followed by a reception on Friday evening. The last session of the Association will be held in the American Museum of Natural History, where Dr. Bickmore will give an address and the exhibits will be opened.

THE GERMAN 'NATURFORSCHER UND AERZTE.'

THE seventieth Congress of German Men of Science and Physicians, under the Presidency of Professor Waldeyer, which met at Dusseldorf, beginning on September 19th, was attended by more than two thousand members. Three general addresses were given, an abstract of which we find in the *Naturwissenschaftliche Rundschau*. The first of these, by Professor Klein, the mathematician, discussed the relation of the German universities to the technical schools. He argued that the university should extend its laboratories and teaching to include technical studies, following here, it appears, the model of the American university. Applied science was further emphasized by the fact that one of the general addresses was for the first time on an engineering subject, and also by the fact that a section of applied mathematics and physics was organized. The third of the addresses was by Professor Tillmann, of Leipzig, on the progress of surgery during the past hundred years.

At the second general session addresses were made by Professor Martius on the causes of illness, in which he argued that the pathogenic microbes were not the true cause, but only the occasion, of illness. Dr. Mendelssohn spoke on the care of the sick and Professor Van't Hoff on the importance of inorganic chemistry. In addition to these two general sessions, there were held combined sessions devoted, respectively, to the sciences and to medicine. In the first of these Professor Krohn spoke on an engineering topic and Professor Pietzker on philosophy and science. Papers were presented before the second group by Professor von Frey, Professor Krehl and Professor Thoma on the heart and the circulation of the blood.

The place of meeting for next year is Munich, and Professor Neumayer, of Hamburg, the eminent meteorologist is President.

GENERAL.

THE fiftieth anniversary of the death of Berzelius has been celebrated at Stockholm by a memorial service, at which the King was present. Professor P. Th. Cleve, who holds the chair of chemistry at Upsala, delivered an oration.

DR. O. LOEW, known for his contributions to chemical physiology, has accepted an appointment under the U. S. Department of Agriculture.

THE International Congress of Mathematicians will meet in Paris from 6th to the 12th of August, 1900. The Mathematical Society of France has appointed committees of organization, M. Poincaré being President of that con-

cerned with scientific papers, and M. Darboux of that concerned with the other arrangements.

ON September 20th a general meeting of the German Botanical Society was held, in connection with the Congress of German Men of Science and Physicians. The session was chiefly devoted to memorial notices of members who had died during the preceding year. The record represented a heavy loss to botanical science.

THE annual general meeting of the London Mathematical Society will be held on November 10th. We learn from *Nature* that Lord Kelvin has acceded to the request of the Council, and will be nominated for the office of President. Professor H. Lamb, F.R.S., will be nominated for a Vice-Presidentship. Professor Elliott, F.R.S., has chosen, for the subject of his address, 'Some secondary needs and opportunities of English mathematicians.'

THE *Botanical Gazette* states that Mr. M. A. Carleton is now in Russia, as an agent of the U. S. Department of Agriculture, to study the cereals of the region.

MR. R. H. W. T. HUDSON, of St. Johns College, is this year senior wrangler at Cambridge University. The *Bulletin of the American Mathematical Society* calls attention to the fact that he is the son of Professor W. H. H. Hudson, professor of mathematics in King's College, London.

THE Royal College of Surgeons, of England, has awarded Drs. G. T. Brodie and Cartwright Wood £50 each from a research grant for their investigations. Dr. Brodie is at present engaged on the chemistry of diphtheria antitoxin, and Dr. Cartwright on diphtheria toxins and antitoxins and a method of examining water bacteriologically.

PROFESSOR FOSTER is giving this term at Cambridge University a course of lectures on the history of physiology. The first lecture of the course, given October 24th, was on Claude Bernard.

WE have to record the death of Dr. J. Crocq, professor of pathology in the University of Brussels and a member of the Belgian Senate; of Heinrich Theodor Richter, the metallurgist, lately Director of the School of Mines at Freiburg; of Dr. C. G. Gibeli, professor of botany and Director of the Botanical Institute at Turin; of the geographer Francisco Coello de Portugal, in Madrid, and of Dr. B. Kotula, known for his researches on the distribution of plants.

THE Civil Service Commission announces that on November 22, 1898, examinations will be held for the position of statistical field agent, U. S. Fish Commission. The chief subjects of the examination are commercial fisheries and the compilation of statistics. The salary is not given in the notice sent us. Vacancies in the grade of electrical engineer will be filled by examination, on December 3d. One of the vacant positions is in New York, with a salary of $1,800 per year. The other is at Fort Caswell, with a salary of $900.

THE International Otological Congress will meet in the Examination Hall of the Royal College of Surgeons, London, in August, 1898.

THE Eastern Association of Physics Teachers met in Boston on October 29th. The subject for special discussion was the relation of mathematics and physics in secondary schools, papers on which were presented by Professor A. B. Kimball and Dr. Levi L. Conant.

THE Council of the Institution of Civil Engineers of Great Britain have made the following awards, out of the trust funds at their disposal for the purpose, for original papers dealt with during the year 1897–98. The formal presentation took place at the Institution on Tuesday, November 1st, at 8 p. m.: Telford medals and premiums —A. H. Preece (London) and H. C. Stanley (Brisbane, Queensland); Watt medals and premiums—H. L. Callendar, M.A., F.R.S. (London), and J. T. Nicolson (Montreal, Canada); George Stephenson medals and premiums—Whately Eliot (Plymouth), W. O. E. Meade-King (London) and W. P. Marshall (Birmingham); the Crampton prize—E. W. Anderson (Erith); Telford premiums—L. B. Atkinson (Cardiff), Henry Fowler (Horwich), W. L. Strange (Bombay), F. J. Waring, C.M.G. (London), D. W. Brunton (Denver, U. S.), Wilfred Airy, M.A. (London), E. M. Bryant, B.Sc. (Newcastle-on-Tyne), D. B. Butler (London)

and H. V. Champion (Victoria); the James Forrest medal—W. L. Brown, M.Sc. (London); Miller prizes—C. E. Wolff, B.Sc. (Derby), A. D. Keigwin (Ashford), Harold Williams (Kingston), J. T. Morris (London), H. C. Adams (Birmingham), H. O. Eurich (Bradford), B. K. Adams (Colombo), A. B. E. Blackburn (Wednesbury), Thomas Carter (Newcastle), P. F. Story (Manchester), D. E. Lloyd-Davies (Bewdley) and Wilfred Hall, B.A. (Corbridge-on-Tyne).

At the meeting of the Entomological Society, London, on October 5th, Mr. R. Trimen, the President, announced that the late Mrs. Stainton had bequeathed to the Society such entomological works from her husband's library as were not already in its possession. This bequest was of great importance, and would add to the library a large number of works, many of which, formerly in the library of J. F. Stephens, were old and now scarce.

According to the *American Naturalist* the University of California has been presented by the Alaskan Commercial Company, of San Francisco, with the large and valuable collections which the Company has been accumulating for many years. The ethnological portion of the collection is especially rich and doubtless one of the best in existence. The collection also embraces fossil remains of mammoths and many skins and mounted specimens of birds, mammals and invertebrates of the Alaskan region.

The Anatomical Museum of Cambridge University has received from Professor Flinders Petrie a donation of 19 cases of skulls and bones from his excavations at Hierakonpolis, Egypt. This is the second donation of the kind received from him, and as these include the remains of the pre-historic and earliest dynastic races they are of great value. With this addition the collection of specimens of Egyptian anthropology is thoroughly representative, as it now consists of specimens which represent all the periods of Egyptian history from pre-historic times down to the Battle of Tel-el-Kebir.

The certified circulation of the libraries of New York City applying for public aid was last year 2,625,142 volumes; the libraries, without exception, showing an increase over the preceding year. The Astor and Lenox Libraries received, during the year ending June 30th, 27,800 new books, surpassing the accessions of the British Museum. The number of readers was 130,000, as compared with 180,000 in the British Museum.

Mr. John Corbett, formerly M.P. for Mid-Worcestershire, has offered to give £50,000 for founding and endowing a school of agriculture for sons of tenant farmers of the county of Worcestershire.

Mr. R. P. Cobbold, the English traveller, who was arrested in Bokhara by order of the Khan a short time ago, has returned, says the New York *Evening Post*, to Kashmir, having accomplished his journey to the Oxus. Unfortunately, he was obliged to throw away all his luggage, and has thus lost most of the scientific collection which was the primary object of his journey.

Captain Novitsky, of the Russian general staff, has returned from a journey through British India. Though the expedition was for political purposes, he brought back rich botanical and entomological collections, and made valuable meteorological observations.

The Vienna Academy of Sciences has, according to the *Athenæum*, chartered the Swedish steamer Gottfried for its projected scientific expedition to south Arabia. The ship is expected to arrive in a few days at Trieste, where the members of the expedition will go on board. The leader of the party is Count Carl Landberg, the Bavarian Orientalist, who has already spent several winters in the district. Dr. H. Müller proposes to devote his researches to the Sabæan inscriptions and the pre-Arabic archæology.

Three deaths have now resulted from infection with bubonic plague, contracted in the first instance in Professor Nothnagel's laboratory, where work was being done with cultures of the bacillus brought there from Bombay a year ago by the Austrian Commission. Men of science are fully aware of the danger from such experiments, but do not hesitate to risk their lives for the advancement of knowledge that may prove of inestimable value. The most serious aspect of the case is the evidence given of the susceptibility of Europeans to the plague. The dis-

ease contracted was of the pneumonic form, which is especially contagious and is usually fatal, but the possibility of its extension in Europe has unfortunately been demonstrated. This is not likely to occur at Vienna, where every precaution has been taken to isolate those infected and to destroy all cultures and animals under experiment. But the plague may at any time be imported from the present epidemic centers in India, and may obtain a foothold before it is detected. It will be remembered that the last epidemic of the 'black death' in Great Britain was the great plague of London, in 1665, when 70,000 persons died.

THE Indian government has determined to appoint a special commission, says the *British Medical Journal*, to consist of five members, to conduct investigations regarding the plague. The specific duty of the commission will be to inquire into the origin of the various outbreaks of the plague and the manner in which the disease is spread. An official statement also is required as to the efficacy of the serum treatment and the prevention of plague by means of inoculation. So far as the nominations on this commission have been made public, two Indian civilians, Messrs. J. R. Sewwett and A. Cumine, have already been appointed, but it is understood that three other members will be nominated by the Secretary of State for India to proceed from this country, of whom one will act as chairman, while two will be experts. There is plenty of work for the commission to do. Plague, as Dr. Simpson in his address at Edinburgh stated, has demonstrated the absolute necessity for a trained sanitary service for India, and, although the intended commission may work out the scientific bearings of the epidemic of plague, it must be remembered that plague is but one of the epidemics which ever threaten India. Plague is but an expression of the general insanitary state, and any governmental inquiry which does not deal with the general relief of the insanitation of India will but touch the fringe of the evil. A sanitary service, complete in all its branches, administrative, investigative and scientific, is required in India.

THE Harveian oration was delivered at the Royal College of Physicians on October 18th by Sir Dyce Duckworth. According to the report in the London *Times*, after urging the claims of the College to the consideration of generous benefactors, he pointed out that Harvey had definitely charged them to encourage research. What were greatly needed now in England were research laboratories attached to hospital wards and *post-mortem* theatres, and also a select staff of fully-trained investigators available for service throughout the Empire. It was surely humiliating that researches were permitted to be made for the public benefit in various parts of British territory by foreigners, while many of their countrymen and countrywomen, owing to ignorance and mawkish sentimentality, were doing their best to debar the training of such men in England. After alluding to the results of recent pathological research in regard to the preventive treatment of tuberculosis, Sir Dyce Duckworth observed that the Röntgen rays have as yet yielded little new information, and their therapeutic influence was not determined, but according to Rieder, of Munich, the rays emitted from high-vacuum tubes killed bacteria. The influence of glycerine in destroying some of the most noxious microbes which gained access to ordinary vaccine lymph was very noteworthy, and he could not but imagine that this agent might yet be found of more extended usefulness as a bactericide. Expressing his private opinion, though he believed it to be shared by the majority of those he addressed, he did not hesitate to stigmatize the recent Vaccination Act as a piece of panic legislation, a lamentable concession to ignorance, fraught with serious peril to the whole community, and unworthy of the duty and dignity of any British government. He closed with a brief appreciation of Harvey's chief scientific achievements, and of his great guiding principle, devotion to truth.

THE office of Regents of the University of the State of New York calls attention to the fact that the last few years of this century are witnessing greater activity in building and equipping medical schools than any other period. At no time in New York State history has so much been done as within the past few years to advance the interests of medical education. The advanced requirements for license, instead

of causing any hardship, have been accompanied by extraordinary growth in the property of New York medical schools. The report for 1897 showed an increase since 1893 of more than 100 per cent. in total property, and of nearly 100 per cent. in annual receipts. Since that time even this great increase has grown still larger, especially in Greater New York. The University and Bellevue Hospital Medical College has the fine new building erected in 1897 by the Faculty of the Bellevue Hospital Medical College. The College of Physicians and Surgeons, with the Vanderbilt Clinic, doubled in size by the additional gift in 1895 of $350,000, and the Sloan Maternity Hospital, greatly enlarged in 1897, now make the most complete plant in existence for scientific medical education. The Polhemus Memorial Clinic has been completed and thoroughly equipped since the last report, providing accommodations for the out-patient and medical school departments of the Long Island College Hospital. The intention of Mrs. Polhemus, that everything pertaining to the construction and equipment of this building should be of the most approved type, has certainly been carried out. Through the medical division of the Flower Hospital, opened in 1896, the New York Homeopathic Medical College now gives an excellent opportunity for the study of practical medicine. The New York Medical College and Hospital for Women has just opened its handsome new building in West 101st street. Last, but not least, $1,500,000, the greatest amount ever devoted by one person at one time to purposes of medical instruction, has just been given to build, equip and endow the new medical department of Cornell University in New York City.

The *Annales d'oculistique*, as quoted in the London *Times*, reports an important decision on 'Scientific Criticism of Proprietary Articles,' given in March last by the civil tribunal of the Department of Seine-Inférieure. The time during which an appeal might be lodged having elapsed, it has now become an expression of the French law upon the point. The question arose in an action for damages, to the extent of 20,000 francs, brought by a firm of opticians in Paris against Dr. Javal, the Director of the Ophthalmological Laboratory of the Sorbonne. The plaintiffs were the proprietors of a glass containing baryta, from which they manufacture spectacle lenses, which were described as 'isometropic,' and were extensively advertised as possessing special excellencies. Dr. Javal instructed two of his assistants, MM. Durault and Tscherning, to institute a careful examination of the glass and of the lenses made from it, and to report fully to him upon the subject. They carried out his instructions, and reported that the differences between baryta glass and ordinary glass were insignificant; that they were not in favor of the former, and that the 'isometropic' lenses did not offer any advantages to purchasers. Dr. Javal published this report by presenting it to the French Academy of Medicine, and hence the action. The Court decided that a scientific man might rightly examine and criticise, on public grounds, any manufactured article for which special merits were claimed, and they found for the defendant upon all the issues, condemning the plaintiff in costs. The decision has been received with much satisfaction by the medical profession in France, and the liberty thus secured is likely to be employed with reference to many pharmaceutical preparations and alleged remedies.

The Annual Congress of the Sanitary Institute of Great Britain was opened at Birmingham on September 17th with an attendance of 800 members. In his presidential address, as reported in the *British Medical Journal*, Sir Joseph Fayrer surveyed the progress of preventive medicine or hygiene during recent times. In bringing about that progress the Sanitary Institute had taken an important part. He described the conditions under which the people lived fifty years ago, and contrasted them with the present conditions. Upwards of 200 millions had been spent on sanitary work with great benefit to the public health. Popular teaching ing and example and the general diffusion of of education were still necessary in order to convince the proletariat of what so intimately concerned their vital interests. It would perhaps not be until the more complete organization of the public health administration under a Minister of Public Health were effected that the full benefits of sanitary legislation would be realized, and the people attain to that standard of health

and duration of life for which they had a right to hope. He showed the effect of hygienic measures upon certain well-known diseases, and with regard to vaccination he said the evidence seemed to show that there could be no doubt as to its value. As to the methods by which every individual was to be vaccinated or revaccinated, that was a subject for the State to determine. That the Acts in existence up to the present time were inadequate to this end was plainly shown by the fact that large and increasing numbers of the population were known to be unvaccinated, despite the compulsory character of the Acts. The most recent Vaccination Act, whatever might be its advantages, was certainly defective in this—that it made no provision for revaccination, the necessity for which was universally admitted by the medical profession, whilst it was very doubtful whether the modification of the compulsory clauses would have the effect, as it was hoped, of extending vaccination. The scope and aim of sanitary science in its preventive aspects should not be limited to the consideration of zymotic and other acute diseases, but should extend to the results of abnormal social conditions arising out of the strain and struggle for existence, involving over-competition in various occupations by which life was supported or wealth and distinction acquired, and under the pressure of which so many lost their health or even succumbed. He quoted from the Registrar-General's returns to show the influence exerted on vital statistics by sanitary science. He dwelt at some length upon the beneficial results of sanitary work in India, and concluded by saying that evidently a great future was before preventive medicine, and they might confidently look to the eminent men of science who were now pursuing with such indefatigable zeal their researches into the mysteries of bacteriology for its fulfillment. But those who admired and appreciated their work the most and looked forward hopefully to its results were anxious that progress should not be retarded by hasty deduction and premature generalization, which might only end in disappointment, however great might be the importance of the study of bacteriology and the various conclusions resulting from it.

UNIVERSITY AND EDUCATIONAL NEWS.

BY the will of the late Dr. Albert S. Hunt the sum of $30,000 was bequeathed to the Wesleyan Library as a permanent endowment fund. The University received also Dr. Hunt's own library of 5,000 volumes. Dr. Hunt was graduated from Wesleyan University in 1851.

MR. W. C. MACDONALD has given a further sum of over $25,000 to the electrical department of McGill University, Montreal.

TRINITY COLLEGE received a donation of $10,000 by the will of the late Nathan Warren, of New York.

AT the annual meeting of the Governors of University College, Liverpool, on October 15th, the Earl of Derby, President of the College, stated that the most pressing needs of the institution were a building for the department of physics and one for the department of human anatomy. The latter would cost about £20,000, and towards this sum the Earl of Derby subscribed at the time £5,000 on condition that the balance be collected. Mr. Ralph Brocklebank subscribed £2,000.

PRESIDENT SCHURMAN has presented his sixth annual report to the Board of Trustees of Cornell University. Reference is made to three important benefactions that we have already recorded; the gift of an infirmary, richly endowed; the establishment of a New York State College of Forestry, supported by the State and administered by the University; and the foundation of the Cornell Medical College, in New York City. The following figures are given concerning the financial affairs of the University:

Value of buildings and grounds	$1,796,372 86
Equipment of departments	1,135,308 12
Invested funds	6,446,818 21
Total property	9,378,499 19
Receipts from tuition	121,205 83
Total income	583,050 73
Total expenses	570,586 36
Salaries	286,185 72

The number of regularly enrolled students was 1,835.

THE registration in the various departments of the University of Michigan, on October 25th, is indicated in the following table. The cor-

responding figures for October 25, 1897, are also given:

	1887	1898
Literary department	1276	1254
Engineering department	269	245
Medical department	425	407
Law department	710	713
Dental department	218	230
Homœopathic department	59	60
Pharmaceutical department	76	73
	3033	2982

THE attendance in Oberlin College shows a falling off of nearly one hundred, the figures to date being 1,040 as compared to 1,135 last year. The increase in tuition may account for part of the loss. Tuition now is placed at $75.00 per year.

DR. JOHN GUITERAS, professor of pathology in the University of Pennsylvania, will resign at the close of the present year to accept the chair of the practice of medicine at the University of Havana. Dr. Guiteras has been greatly interested in the liberation of Cuba and wishes to build up the medical courses in the University of Havana.

C. E. MENDENHALL, PH.D. (Johns Hopkins), has been appointed instructor in physics in Williams College. Dr. J. C. Hardy has been appointed instructor in mathematics in the same institution.

THOS. CLARKE, B. S. (University of N. C., '96), Ph.D. (Bonn, '98), has been appointed assistant in chemistry at the University of North Carolina.

AMONG foreign appointments we note that Dr. Frentzel has been promoted to a professorship in the Agricultural College at Berlin and Professor Wälsch to a professorship of mathematics in the Technical Institute at Brünn. Dr. H. E. Ziegler, of Freiburg, i.B., has been appointed successor of Professor Kückenthals, 'Ritter' professor of phylogeny in the University at Jena; Dr. E. Reinbach, of Berlin, professor in the Chemical Institute at Bonn, and Dr. Fenner, of Aix, professor of geodesy in the Technical Institute at Darmstadt. At Vienna, Dr. Zukal has been made professor of phytopathology in the Agricultural College, and Dr. Ritter Lorenz V. Liburnau has qualified as docent in zoology; in the University Dr. Werner has qualified as docent in zoology, and Dr. Reithoffer in technical electricity.

DISCUSSION AND CORRESPONDENCE.

MEASUREMENTS OF PRECISION.

AN article in the *Physical Review*, September-October, 1898, by S. N. Taylor, should not be overlooked by those who are interested in knowing the degree of precision which may be reached in linear and other measurements.

The paper itself should be consulted, but a few of Mr. Taylor's most remarkable accomplishments may be mentioned here. It comes in his way to measure several diameters of a coil of wire, consisting of fifteen layers, with fifteen turns in each layer, the mean diameter of the coil being about 20 cm., and the wire being *No. 18, copper, double-silk insulated, passing through a bath of hot paraffine during the process of winding.*

It is wound upon a cup-shaped cylinder of plaster of Paris, which was soaked in a mixture of linseed oil and liquid dryer sometime before its use. Mr. Taylor tabulates his measurements of these diameters, each layer, as it is wound on, in figures carried to *thousandths and ten thousandths of a millimeter*, thus implying that his measures are made to one part in two millions.

They are made, he says, by means of a cathetometer, before which the coil is mounted on an axis, that it may be turned into six different positions. Unfortunately, he does not say how far the coil was from the cathetometer, or give the name of the maker of an instrument of a type so extraordinary as to justify these figures on the diameters of a wire coil. Still more unfortunately, he fails to give the results of several independent measurements in each position, which he says were taken.

A thousandth of a millimeter is always worth struggling for, and, as a variation of a single degree in the temperature of his cathetometer bar would probably change its length by 15 or 20 of them, it is to be inferred that highly perfected methods of determining that temperature were used, although the author is also silent on that point. The level on the cathetometer

telescope must have been an uncommonly sensitive and well-behaved attachment, the name of the maker of which should not be concealed. It cannot be that these measurements are in any degree doubtful, for, otherwise, Mr. Taylor would hardly use them, as he has, in computing the constant of his instrument, in which operation he carries results to eight significant figures, the unit of the last place in his final mean standing for about *one part in thirty millions*. A 'sudden drop' is experienced, however, in the very next paragraph, where he says that the same calculation has been made by other people and by a different method, resulting in a quantity differing from the former by about one part in five or six hundred, and which he proceeds to use instead of the result of his own labors.

But it is not in linear measurement alone that marvelous skill is shown in this piece of work. There is weighing which must also excite admiration. A movable coil of the same kind of wire, which must have weighed not much less than a kilogram, was suspended from the arm of a balance; and the 'pull' on this coil, amounting, it is inferred from the tables, to about 23 grams in one case and about 45 grams in another, was weighed to within one-tenth of a milligram. This, of itself, is not, perhaps, remarkable, but it becomes so when it is remembered that this coil is anchored to solid ground by two thin slips of 'crimped' sheet copper, 7 mm. in width. The getting of a tenth of a milligram under such conditions implies rare skill. But the reader is again doomed to bitter disappointment when he is informed that the result of all this exquisite work is to give a value for the E. M. F. of a Clark cell differing from all of the many good determinations that have been made before by more than one part in two hundred and fifty or nearly one-half of one per cent., and that the author himself concludes that, as absolute measurements, his results 'don't count.'

'Figuratively speaking,' Mr. Taylor's paper is, or ought to be, almost unique, but it is only justice to him to add that it really contains much that is interesting and valuable from points of view other than that of metrology.

X.

LIFE-ZONES IN NEW MEXICO.

A NEW bulletin by Dr. C. H. Merriam has just come to hand from the Department of Agriculture, entitled 'Life-Zones and Crop-Zones.' It contains a colored map showing the zones, and a great deal of valuable information about the agricultural products of each zone. On p. 13 it is stated:

"The colored maps prepared by the Biological Survey furnish the first rational basis the American farmer and fruit grower has ever had for the intelligent distribution of seeds and the only reliable guide he can find in ascertaining beforehand what crops and fruits are likely to prove successful on his own farm, wherever it may be located."

On p. 7 it is stated that "great care has been taken to make the lists accurate and trustworthy *as far as they go*." Also, "the intention in the present report is to omit doubtful records."

On p. 42 we find these words: "Raisins and wine grapes, oranges, lemons, olives, prunes, peaches, apricots, English walnuts and almonds are among the important products of the Lower Sonoran area, and the fig ripens several crops each year." Immediately following is a list of the crops of the Lower Sonoran, including even guavas and the loquat, among a variety of other things.

On p. 41 it is said that the Lower Sonoran "sends an arm northwest to a point a little north of Albuquerque, New Mexico. Another arm reaches up the valley of the Pecos." The map shows these arms, the Pecos valley one going about to Eddy. These arms are colored as typical Lower Sonoran, and no word appears in the text to suggest otherwise.

On pp. 15–17 the special value of these arms is insisted upon, because "by growing particular crops at points remote from the usual sources of supply, and at the same time conveniently near a market, the cost of transportation is greatly reduced and the profit correspondingly increased."

After all this, the reader will be surprised to learn that heavy frosts occur annually in the supposed Lower Sonoran arms in New Mexico, and that the cultivation of oranges, lemons or olives is totally out of the question anywhere within the bounds of the Territory. The fig,

so far from ripening several crops annually, is killed down every winter, except in sheltered places, as between four walls, and does not produce any crop unless thus protected. In short, the products of the Rio Grande and Pecos valleys in New Mexico are *Upper Sonoran*, not Lower Sonoran at all, although it is true that there are some elements in the fauna and flora which may even be called neotropical.

These facts are not new, nor is this criticism of Dr. Merriam's map here made for the first time. In the plainest possible language, I drew attention to the real status of the case in Bull. 15, of the N. M. Experiment Station, January, 1895, pp. 54, 55. Again I protested against Dr. Merriam's mapping in Bull. 17 of the same station, April, 1896, p. 100. Still again the subject was discussed in Bull. 24 of the same station, August, 1897, p. 7, etc. In the publication last cited are quotations from an excellent letter by Dr. T. S. Palmer, of the Biological Survey, admitting that the products assigned to the Lower Sonoran do not grow all over that area as mapped; but in the work now criticised there is no hint of this.

Professor C. H. T. Townsend, who has long studied the distribution of life in New Mexico, has also expressed himself clearly and explicitly on the point at issue. He further explains the limits of the Lower Sonoran in Arizona, Mexico and Texas, on pp. 84, 85 of his paper in the Proceedings of the Texas Academy of Science, vol. 1. In a second paper in the same Proceedings he has further discussed the fauna and flora of Mexico and the southwestern United States, giving many new facts and arguments.

Neither Professor Townsend nor the present writer imagine that we are within a measurable distance of reaching final conclusions on zone-distribution in the West; but the facts mentioned above, ignored by Dr. Merriam, are matters of common knowledge to every inhabitant of this region. Certain persons interested in the sale of lands have from time to time circulated false statements as to the products of southern New Mexico, which statements have been duly corrected. But now, for their most extravagant assertions, they can fall back on the authority of the Chief of the Biological Survey!

We all owe thanks to Dr. Merriam for the large amount of extremely valuable work he has accomplished during the last ten years, but this fact cannot protect him from criticism when he deliberately reissues misleading statements and maps, totally ignoring the protests of those who are working in the region discussed. He not only perpetuates a scientific error, but runs the risk of seriously misleading those farmers whom he invites to guide their operations by his aid.

T. D. A. Cockerell.

Mesilla Park, N. M.,
September 22, 1898.

Mr. Cockerell finds fault with me for including certain parts of the valleys of the Rio Grande and Pecos in the Lower Sonoran Zone, and makes the positive statement that they are in the Upper Sonoran Zone. At the same time he admits that the faunas and floras of these valleys are mixtures of at least two zones. In this I quite agree with him. He considers the preponderance of species Upper Sonoran; I considered it Lower Sonoran. The difference between us, therefore, relates to the position of the boundary line—a line separating adjoining belts in a narrow valley. He thinks I have carried it too far north. He may be right. But he omits to quote from my Bulletin an important statement intended to cover this class of cases. In discussing the northern arms of the Carolinian faunal area I said: "These arms, like nearly all narrow northward prolongations of southern zones, do not carry the complete faunas and floras of the areas to which they belong, but lack certain species from the start and become more and more dilute to the northward till it is hard to say where they really end. Their northern boundaries must be drawn arbitrarily, or must be based on the presence or absence of particular species rather than the usual association of species."

This seems to dispose of the main point of Mr. Cockerell's criticism. The absurd claim that all the crops mentioned as growing in a particular zone will grow in all parts of that zone has never been made by me. And as to the map, it seems hardly necessary to say that one on so small a scale as that accompanying the paper in question can hardly be expected to

show the degree of purity and extent of overlapping of contiguous parts of adjoining belts.

In conclusion, I beg to express the hope that my protracted absence in remote parts of the West, while engaged in tracing the boundaries of the life zones, may ameliorate my offense in not having seen all of Mr. Cockerell's writings.

C. HART MERRIAM.

SAN FRANCISCO, CAL., October 11, 1898.

SCIENTIFIC LITERATURE.

Angewandte Elektrochemie. Zweiter Band: Anorganische Elektrochemie. Dritter Band: Organische Elektrochemie. Von DR. FRANZ PETERS. Hartleben's Verlag, Wien; Pest, Leipzig.

The first volume of this book was reviewed in SCIENCE by Professor Smith (April 9, 1897). In the light of this notice of the general purport of the book by so able an authority, attention need only be called to the appearance of the subsequent volumes and to their contents. The second volume, on the electrochemistry of inorganic substances, is divided into two parts. The first deals with the electro-chemistry of the metalloids and alkali metals, including methods of obtaining hydrogen, of purifying water, of obtaining chlorine, bromine and iodine, oxygen and ozone, arsenic and antimony. It is interesting to note under carbon that it volatilizes at about 3,600° in the arc of the electric lamp, and that Moissan has succeeded in converting it into vapor in the electric furnace. It did not, however, assume the liquid state, but passed at once into vapor. The beautiful work of Moissan on highly heated carbon is taken up at some length. The electrolytic separation of lithium and sodium is then taken up, the methods of Grabau, Borschers and Castner in the production of sodium receiving special treatment.

The second part of the second volume is devoted to the alkaline earths, the earths and heavy metals.

The third volume deals entirely with the electro-chemistry of organic compounds. The extent to which organic compounds can be prepared by the action of the current is shown by the number of classes of substances included in this volume. In the paraffin series there are thirteen classes, including hydrocarbons, alcohols, ether, ethereal salts, acids. In the aromatic series there are seventeen classes, including hydrocarbons, nitro, sulphur and amine derivatives of the hydrocarbons, phenols, alcohols, aldehydes, ketones and acids. This volume closes with an account of some of the practical uses of organic electro-chemistry, as electrodyeing, electroprinting, electrotanning, etc.

Insofar as it deals with the electrolytic deposition of the metals, this book covers some of the same ground as the well known work of Borschers, which deals with electro-metallurgy in such a masterly manner. But the work of Peters covers a much wider field, and will doubtless prove to be a valuable contribution to practical electro-chemistry.

H. C. J.

Up-to-date Air-brake Catechism. By ROBERT H. BLACKALL, Air-Brake Inspector and Instructor on the D. & H. Ry. New York, N. W. Henley & Co. 12mo. Pp. 230. Illustrated.

This is a little book, but one of great value in a special field. It is the custom of the makers of air-brakes, and of the management of the best railway systems, to employ an inspector and instructor to go from point to point on the railways, inspecting the brake outfit and teaching its use, as experts. The plan is an admirable one and undoubtedly a most valuable insurance of safety to the traveling public as well as to employees. Mr. Blackall is one of these instructors and inspectors who, with rare discretion, tact and expert knowledge, has written out his instructions in this catechetical form and printed it.

The book is not only unique in its subject, in its completeness and in its comprehensiveness; but it is one which evidences in its plan, in its literary form and in detail, the talent and culture of a man of education, as well as of professional competence. Before January 1, 1900, every train must have sufficient air-brake equipment to control it, and this means the education and training of an army of railroad men of all grades; hence the value of this timely text-book. It includes a discussion of

the details of the equipment, their usual defects, accidents, shortcomings, and methods of remedy, as well as of their every-day management. It is an admirable bit of very useful book-making, and its notice in this place is entirely justified by its scientific character and completeness, as well as by its intrinsic value in its place and for its purpose.

R. H. T.

SCIENTIFIC JOURNALS.

THE *American Naturalist* for October opens with an article by Mr. John Murdoch, describing the relation between the Eskimos of Port Barrow, northwestern Alaska, and the animals of their country. Mr. G. W. Field's article on methods of planktology describing work carried out in The Rhode Island Experiment Station is reprinted from the Report of the Station. Mr. C. R. Eastman discusses some new points in Dinichthyid Osteology, and Professor Comstock and Dr. Needham continue their treatise on the wings of insects. There is a note on the variation of the teleutospores of *Puccinia windsoriæ*, by Mr. J. A. Warren, and editorially the plans for a marine biological station in Canada are discussed. Thirty-four pages are devoted to reviews of literature and scientific news.

Terrestrial Magnetism for September is almost entirely devoted to the recent International Conference on Terrestrial Magnetism and Atmospheric Electricity, reported in a recent issue of SCIENCE. A full account of the proceedings of the Conference is given, likewise the words of welcome addressed to those attending it by the President of Section A, Professor W. E. Ayrton, and the opening address of the President of the Conference, Professor A. W. Rücker. The following papers presented to the Conference are printed in full:

Establishment of Temporary Magnetic Observatories: W. von Bezold and M. Rykatschew.

Relative Advantages of Long and Short Magnets: E. Mascart.

Questions to be addressed to Magnetic Observatories: M. Eschenhagen.

Systematische Erforschung der Saecular Variation: A Schmidt (Gotha).

Magnetic Observations in the Azores: Albert, Prince of Monaco.

Mouvement diurne du pôle nord d'un barreau magnétique: J. B. Capello.

Expression of the Earth's Magnetic Potential: A. Schuster.

Earth Currents, Atmospheric Currents and Magnetic Perturbations: S. Lemström.

Interpretation of Earth Current Observations: A. Schuster.

Magnetic and Electrolytic Actions of Electric Railways.

SOCIETIES AND ACADEMIES.

ENTOMOLOGICAL SOCIETY OF WASHINGTON, OCTOBER 20, 1898.

UNDER the head of short notes and exhibition of specimens Mr. Pratt exhibited a specimen of *Phyciodes tharos* which had been taken at electric light at night. Mr. Schwarz showed a dry flower stem of the bear-grass showing the work of the Buprestid beetle *Thrincopyge ambiens* Lec., the single stem indicating the entire life history of the beetle, which works in the center and does not appreciably injure the plant. Some discussion followed upon the bear-grass and the allied Yuccas and Dasylirions of the arid region, more particularly in regard to the destruction of flower pod by cattle in spite of the especially protective growth. Mr. Heidemann showed three species of Aradidæ new to the District of Columbia, viz., *Aradus crenatus* Say, *A. breviatus* Bergr. and *A. inornatus* Stål., with comments upon their habits and characters. He also showed specimens of *Calisius pallices* Stål., from Florida, a species hitherto known only from South America and which must now be added to the fauna of boreal America. Mr. Ashmead remarked that he had found this last species under the bark of dead orange trees killed by frost. Mr. Howard called attention to an outbreak of the chinchbug upon the lawns in the city of Brooklyn during the months of July and August last, pointing out that the sudden appearance of this insect in enormous numbers in the center of a densely populated city, hundreds of miles from any previous point of destructive appearance and in the middle of a summer characterized by excessive precipitation and upon closely-cut lawns which had been frequently watered, afforded an instance entirely unprecedented in the history of the species.

Dr. Dyar read the first paper of the evening, entitled 'Notes on Acronycta and their Larvæ,' in which he spoke of a forthcoming work on these insects prepared by himself and Dr. J. B. Smith. He called especial attention to the fact that his own classification of the group from the larvæ coincided in a remarkable manner with Dr. Smith's classification of the group derived from the study of the adult characters only. He showed that the larvæ may be divided into three main groups, and illustrated his remarks by the exhibition of specimens.

Mr. Schwarz presented a communication on the insect fauna of southern Arizona. The aquatic and riparian insect faunas are well represented, but do not offer any distinguishing features in their mode of appearance or development. In many rivers and most of the creeks the water sinks below the surface of the ground for a longer or shorter period during spring and early summer, and in this period the insect fauna—imagos and larvæ—follow the moisture underground and remain dormant until the advent of the July and August rains. There is a small but interesting winter flora and fauna in southern Arizona, as exemplified by the canaigre plant (*Rumex hymenosepalus*) and the various insects infesting the same. Both the plant and the insect retire underground in February and remain dormant until the following October. The great increase of temperature from April until the end of June has but little influence upon the development of insect and plant life, and the insect fauna at this season is comparatively poor in species. By far the greater portion of insects, and among them the most characteristic species, do not appear before the beginning of the rainy season in July. Their appearance is governed not by the increase of temperature, but by the increase of humidity.

L. O. HOWARD,
Secretary.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE regular meeting of the New York Section of the American Chemical Society was held last Friday evening at the College of the City of New York, with an attendance of fifty-one members, Dr. Wm. McMurtrie presiding.

An informal report was made as to the progress in organizing a chemical club, in which it was stated that the matter is in the hands of a committee of which Dr. C. F. Chandler is chairman, and the subject is being actively canvassed.

The question of inviting the Society at large to hold the mid-winter meeting in New York was then taken up for discussion, and on final motion the vote was unanimous in favor of it, and committees of arrangements were ordered appointed.

The death of Dr. Bromwell was then announced and a brief sketch of his career presented.

The following papers were read:

(1) Aug. E. Knorr, 'An Extraction Apparatus with a Novel Accessory.'

(2) Albert C. Hale, 'A Statement of the Work accomplished at the General Meeting of the Section in Boston.'

(3) William McMurtrie, 'Some Records of the Year's Progress in Applied Chemistry.'

Dr. Hale stated that the membership of the Society is now 1,378; that of the Section 285, and that of the recently organized New England Section is already over 200, the new members elected since September 1st numbering about 60. The growth of the Boston Section has been phenomenal, and it is already one of the strongest.

Dr. McMurtrie's review of 'Progress in Applied Chemistry' was full of interesting material' and could well have been divided between two or more meetings, with time for digestion and discussion.

The next meeting of the Section will be held on the 11th of November, at which it is expected that a well known expert in the chemical technology of glass-making will be present and will read a paper.

DURAND WOODMAN,
Secretary.

ENGELMANN BOTANICAL CLUB.

THE Club met at the St. Louis Medical College on Thursday, September 22d.

Mr. C. H. Thompson presented some brief notes on the pollination of the species of *Thalia* native to the United States. In his study of the

flower structure, together with observations upon plants grown in the water gardens of the Missouri Botanical Garden and Tower Grove Park, he finds they are especially adapted to the visits of large bees. The flower is so constructed as to utilize these visits in effecting cross-pollination. The pistil is held under tension in a manner similar to the bowed stamens in *Kalmia* by one of the lower staminodia. This staminodium is folded about the pistil in much the same way that the keel of a papilionaceous leguminous flower surrounds the stamen column, though much more closely and tenaciously. One margin of the keel develops two bristles, the posterior of which is in the direct path to the nectary. This bristle proves to be highly sensitive, and transmits an impulse to the part of the keel clasping the pistil, allowing the latter to suddenly rise and coil in a spiral motion. Before the flower opens the anther cell dehisces and sheds its pollen on a viscid disc which is situated on a style immediately back of the stigma. The stigmatic surface itself forms a funnel-shaped excavation in the end of the pistil. When a bumble-bee alights on the broad petaloid staminodium which forms the platform of the flower it thrusts its beak directly forward, under the canopy-shaped upper staminodium, into the drop of nectar which is clearly visible. By this act the beak strikes the sensitive bristle, which in turn releases the pistil. This rises with a sweeping, spirally-coiling motion which brings the stigmatic surface in contact with the base of the bee's beak, scraping into it any pollen that may have been previously deposited there. Then in its further motion the pistil deposits more pollen, from the viscid disc, upon the bee's beak at the same spot previously scraped by the stigma. This is to be carried to another flower. Finally the pistil comes to rest with its stigma snugly buried in a little wall pocket formed by a fold of the inner surface of the upper staminodium, thus excluding any possibility of further deposits of pollen upon it. Immediately this takes place the petaloid staminodia begin to wither and so discourage any further visits of insects.

A discussion of the flora about Crêve Coeur Lake followed.

The Club met again on Thursday, October 13th, fifteen members present. Mr. J. B. S. Norton discussed the modes of branching found in Euphorbiaceæ, and explained the structure of the flower, illustrating his remarks with numerous specimens. Miss N. M. Gladfelter spoke on edible mushrooms, and exhibited some forty species collected in and about St. Louis on one afternoon. Professor W. R. Dodson reported upon some results of growing soy beans of different colors. By selection it was possible to reach two extreme forms as well as all of the intermediate stages.

HERMANN VON SCHRENK,
Secretary.

NEW BOOKS.

Elementary Botany. GEORGE FRANCIS ATKINSON. New York, Henry Holt & Co. 1898. Pp. xxiii + 444. $1.25.

Text-book of Algebra. GEORGE EGBERT FISHER and ISAAC J. SCHWATT. Philadelphia, Fisher & Schwatt. 1898. Part I. Pp. xiii + 683.

The Ice Age, Past and Coming. C. A. M. TABER. Boston. 1898. Pp. 101.

The Genesis and Dissolution of the Faculty of Speech. JOSEPH COLLINS. New York and London, The Macmillan Company. 1898. Pp. 432.

Elements of Sanitary Engineering. MANSFIELD MERRIMAN. New York, John Wiley & Sons; London, Chapman & Hall, Ltd. 1898. Pp. 216. $2.00.

L'Année biologique. 2d year, 1896. IVES DELAGE. Paris, Schleicher Frères. 1898. Pp. xxxv + 808.

Naturæ Novitates. Berlin, R. Friedländer und Sohn. 1898. Pp. 683. M. 4.

Wild Animals I have Known. ERNEST SETON THOMPSON. New York, Charles Scribner's Sons. Pp. 359. $2.00.

Organographie der Pflanzen. 2d vol., Specielle Organographie; 1st part, Bryophyten. K. GOEBEL. Jena, Gustav Fischer. 1898. Pp. xii + 385.

The Philippine Islands and their People. DEAN C. WORCESTER. New York and London, The Macmillan Company. Pp. xix + 529. $4.00.